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PROCEEDING BOOKS

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GUESMI Fatma ^{1,*}, HANNACHI Chiraz ¹, LOUATI Islem, HAMROUNI Béchir ¹

Effect of temperature on the adsorption of fluorides, nitrates and sulfates onto modified AFN membrane.

Desalination and Water Treatment, Vol. 83 (2017), 204 - 211.

Simulation of the solar still under real operating conditions

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ABSTRACT

The present work is a contribution to reduce water deficiency in my country by using the solar distillation means. We propose a model of solar still planted under climatic conditions of the area of Constantine located at eastern of Algeria. A theoretical approach is used to simulate the behavior of some internal and external parameters related to the solar-still with time, and their effects on the system performance during a sunny period. These parameters include the temperature difference between the evaporation surface and that of the condensation, internal heat transfer, water depth, wind velocity, solar radiation, ambient temperature, and external heat transfer. The obtained results show that the productivity is strongly related the solar radiation in the best direction of the still and a large temperature difference between the glass and the water surface improves the daily production. Moreover, shallow water of 0.02 m in basin of still gives higher production. Daily yield of still increases as wind speed increases up to critical value at 10 m/s where production reaches its maximum. The still productivity has increased by 57, 71%, when the wind velocity increases from 2 to 10 m/s. The internal and the external heat transfers affect directly the performance of the still in relation with solar radiation.

Keywords: Solar still; Internal parameters; External parameters; Performance

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Application of Doehlert matrix to determine the optimal conditions of Bromothymol Blue discoloration with Fenton process

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ABSTRACT

The discoloration of a textile dye derivative bromothymol blue (BTB) in aqueous solution with Fenton process (FP) has been studied. The performance of the FP depends on various operating parameters such as the initial concentration of hydrogen peroxide $[H_2O_2]_0$, the initial ferrous ion concentration $[Fe^{2+}]_0$ and the pH of the reaction medium. The optimal conditions of these variables, for the discoloration of BTB with FP, have been investigated by the use of Doehlert matrix. It has been demonstrated that under the optimal conditions ($[H_2O_2]_0 = 1.61$ mM, $[Fe^{2+}]_0 = 0.18$ mM and pH = 2.85), FP leads to a maximum discoloration yield of BTB (67.58%±4.39) after 1 h of treatment. These values were also experimentally validated. The obtained discoloration yield was 70.4%. After 6 h of BTB treatment in aqueous solution by FP, the color removal achievement was 91.54% and, the chemical oxygen demand (COD) removal reached 63%. Carboxylic acids and inorganic ions have been identified and followed during the mineralization of BTB with FP.

Keywords: Bromothymol blue; Fenton process; Discoloration; Experimental design methodology; Doehlert matrix

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Removal of LPS endotoxin from reclaimed wastewater through adsorption using soil

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ABSTRACT

The removal of LPS endotoxin from reclaimed wastewater using four different types of soils was studied at ambient temperature. An efficient removal of LPS endotoxin by adsorption to soils was possible and the best performance was achieved by silt and fine sand. At a dose of 5.8 g/L, more than 90% of the adsorption of LPS endotoxin occurred in less than 3 h of contact time, and further contact time did not improve the adsorption. The removal efficiency depends on the dose of adsorbents. Moreover, LPS endotoxin adsorption is found to depend heavily on the initial LPS endotoxin concentration. A comparison between fresh soils and one-year-old soils (used as wastewater filtration media) showed better performance for fresh soils. In addition, adsorption experiments showed that the adsorption data fit with both Freundlich and Langmuir isotherms. Moreover, the LPS endotoxin concentration to fine sand is highly favourable, i.e., its fixation capacity grows rapidly with concentration in equilibrium in the liquid phase. This explains why, in an earlier study, LPS endotoxin removal using soil columns showed good efficiency in the early stage and then degraded. It can be concluded that soil can be an affordable alternative for LPS endotoxin removal from reclaimed wastewater if properly maintained.

Keywords: LPS endotoxin; Adsorption; Isotherm; Potable reuse

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Theoretical study of various configurations of solar desalination by vacuum membrane distillation

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ABSTRACT

Vacuum membrane distillation is a thermal desalination process characterized by a low operating temperature which gives the possibility to coupling with renewable energy. New systems for producing drinking water from seawater using vacuum membrane distillation coupling with solar energy were simulated. The study of different configurations has allowed us to present the processing advantages and disadvantages of each configuration, and enabled us to suggest recommendations on the choice of the configuration according to the type of membrane and application context. In this work, two types of coupling configuration for the type of collectors were investigated. The models concerning the hollow fiber module, the cylindro-parabolic solar collector (CPC) and salinity gradient solar pond (SGSP) were developed. The simulation of the module model allows for the study of the effect of various parameters such as the temperature, velocity and salinity. Then the coupling between this model and the solar collector model was achieved. The solving of models equation allows the determination of each coupling configuration production along the year. The simulation shows that the production of the integrated module in a solar pond is the most productive configuration confirming the interest of the module integration. This system allows the production to reach about 32.5 m³/y.

Keywords: Solar energy; Desalination; Membrane distillation; Integrated system

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Study of cadmium adsorption onto calcite using full factorial experiment design

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ABSTRACT

Full factorial experimental design technical was used to study the main effects and interactions between operational parameters in batch adsorption of cadmium using calcite as adsorbent. The significant parameters which affect cadmium removal efficiency and adsorption amount, such as initial concentration, adsorbent dose, temperature and contact time, were investigated. Parameters that influence the cadmium removal efficiency from water were evaluated statistically by using factorial plots: the Pareto chart, main effect, interaction effect, contour plot, surface plot and the cube plot. Analysis of variance and p-value significant levels were used to check the significance of the effect on percentage removal. The statistical analysis was allowed to verify that the four studied parameters have an influence on the cadmium elimination (p-values ≤ 0.05 and $R^2 = 0.9652$). It was found that the most effective parameters of adsorbed cadmium amount were initial concentration and adsorbent dose. The interaction between initial concentration and adsorbent dose was the most important factor.

Keywords: Cadmium removal; Adsorption; Water treatment; Calcite; ANOVA; Full factorial design

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Combining adsorption on activated carbon with electrocoagulation process for copper removal from used water

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ABSTRACT

In this work, electrocoagulation (EC) combined to adsorption onto granular activated carbon (GAC) was studied for the removal of copper ions. EC process was firstly optimized. The effect of the main parameters such as: pH (4–8), electrolysis time t_{ec} (5–60 min), current density j (0.277–1.388 mAcm⁻²), conductivity, inter-electrode distance d (0.5–2 cm), area volume ratio S/V (3.6–14.4 m⁻²), initial concentration (10–70 mgL⁻¹), stirring speed (0.0–600 rpm) and the mode of connection (bipolaire-monopolaire) on copper removal were explored. Under optimum conditions (pH = 5.0, j = 1.388 mA cm⁻², t_{ec} = 30 min, d_{ec} = 1 cm, S/V = 7.2 m⁻², stirring speed = 300 rpm and monopolaire connection) 97% copper removal was achieved with an energy consumption of $W = 0.065$ KW hm⁻¹. Combining adsorption on GAC with EC notably reduces the electrolysis required time inducing a strong decrease of energy consumption. The removal of copper from industrial waste water showed the advantage of combining adsorption on GAC with EC in order to reduce the processing time and thus the process energy cost.

Keywords: Electrochemistry; Electrocoagulation; Copper removal; Adsorption onto granular activated carbon

1. Introduction

Heavy metals are the most toxic mineral pollutants which are mutagenic, carcinogenic ... [1,2]. Copper is one of vital element for human. However, if it consumed in surplus amounts, copper can be toxic, and even deadly to organisms [3,4]. For the United States Environmental Protection Agency (USEPA) the highest contaminant concentration for Cu (II) in industrial effluent was fixed at 1.3 mg L⁻¹ [5]. For these purposes, the removal of excess copper from water and wastewater is imperative for saving public health and the environment. Various methods have been used to remove copper ions from water and wastewater including chemical coagulation, biological treatment, adsorption, ultrafiltration, ion exchange and electrocoagulation ... [6].

Recent researches reported that EC and adsorption are the most favorable methods for metals ions removal due to convenience, easy operation, compact treatment, simplicity of design and environmental compatibility [7]. Furthermore, the search for cheap treatment methods has led to the development of combined processes.

EC is an electrochemical process consisting of forming metallic hydroxide flocks within the wastewater by electro-dissolution of sacrificial anodes. The generation of metallic cations takes place at the anode (usually made of iron or aluminum) due to the electrochemical oxidation, whereas at the cathode the production of H₂ typically occurs [8]. When metal ions are neutralized with ions of opposite electric charge provided by an EC system, they become unstable and precipitate in a settled form [9]. These insoluble metal hydroxides react with the suspended and/or colloid solid-sand precipitate.

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Techno-economic and environmental analysis of an integrated solar vacuum membrane distillation system for the treatment of reverse osmosis desalination brine

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ABSTRACT

Reverse osmosis (RO) desalination is widely used for drinking water production, because of its relatively low energy consumption. However, RO is limited in recovery ratio due to the osmotic pressure which increases with salinity. It results with high rejected brine volume inducing negative environmental impact. The aim of this work is to investigate the possibility of using solar vacuum membrane distillation (VMD) in an integrated RO desalination process in order to reduce brine discharge volume and increase RO global recovery ratio. A small RO desalination unit operated by solar energy in a real site in the Algerian desert is considered for the feasibility study. The obtained results proved that important permeate fluxes can be reached with RO coupled with VMD as the water recovery increased from 37% to nearly 87.5%. Brine volume can so be reduced by a factor of 5 and the global water production is more than doubled. A sensitivity analysis was also carried out to study the effects of operating conditions on the desalination system performance in terms of feed water temperature, vacuum pressure and solar collector efficiency. Finally, an economic study was performed to estimate the cost of water produced from the three possible configurations: the RO alone, the VMD alone and the RO-VMD combined system.

Keywords: Reverse osmosis desalination; Brine disposal; Vacuum membrane distillation; Solar energy; Economic study; Sensitivity analysis

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Adsorption of cadmium onto activated alumina: kinetics and thermodynamics studies

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Received 29 December 2015; Accepted 28 October 2016

ABSTRACT

In this study, Activated Alumina was assessed as adsorbent for the removal of cadmium ions from aqueous solutions. Langmuir, Freundlich and Dubinin-Redushkevich (D-R) models were used to study the adsorption equilibrium at different temperatures (283, 298 and 313 K). It was found that the maximum adsorption capacities increased with temperature indicating an endothermic phenomenon. Furthermore, the values of sorption energy estimated for the studied range of temperature by the D-R model were found to be higher than 8 kJ mol^{-1} suggesting a chemisorption reaction. In addition, the correlation of sorption data by kinetic equations showed that the adsorption of cadmium follows the Elovich and the pseudo-second order models which confirms the chemisorption process. The thermodynamic parameters showed that the adsorption of cadmium onto activated alumina was spontaneous, and the positive values of enthalpy change (ΔH°) confirmed the endothermic character of adsorption. In order to further study the cadmium sorption, different techniques were used for the characterization of the activated alumina before and after adsorption. BET measurements shown an increase of the specific surface area. In addition, FTIR and XRD analysis were used to discuss the role of functional groups in cadmium adsorption. Besides, the technical viability of the process was investigated for a wastewater sample. It was found that the activated alumina is an efficient adsorbent for the removal of cadmium from contaminated water, as the reached percentage removal was above 99%.

Keywords: Cadmium; Adsorption; Activated alumina; Kinetic; Thermodynamics

*Corresponding author.

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Effect of temperature on the adsorption of fluorides, nitrates and sulfates onto modified APN membrane

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ABSTRACT

Removal of fluoride, nitrate and sulfate ions from aqueous solutions is the principal objective of many studies concerning water treatment. In this work the modified APN anion exchange membrane was evaluated for the removal of F^- , NO_3^- , and SO_4^{2-} anions from aqueous solution. The APN membrane was modified by adsorption of polyethyleneimine (PEI) on its surface. Surface morphology of the modified APN membrane was compared to the unmodified one using scanning electron microscopy (SEM). The sorption isotherms for fluoride, nitrate and sulfate ions on the modified APN membrane were investigated in the range (0.05–1 mol L⁻¹) at 283, 288, 298, 303 and 313 K. Experimental data were analyzed using the Langmuir and Dubinin–Astakhov adsorption models. The adsorption parameters of the studied models were determined by non-linear regression. The equilibrium data obtained in this study were found to follow Dubinin–Astakhov adsorption isotherm. The effect of temperature on the adsorption of fluorides, nitrates and sulfates has been attempted. It was found that the adsorption of fluoride and sulfate ions increases with rise in temperature. Thermodynamic parameters of the adsorption process have been determined. Obtained results show that adsorption of fluoride and sulfate ions onto the modified APN membrane is an endothermic sorption process while it is an exothermic process for the nitrate adsorption. The values suggest the affinity order for the modified APN membrane. At 283K and 288K the affinity order is: $NO_3^- > F^- > SO_4^{2-}$ and $F^- > NO_3^- > SO_4^{2-}$ at 298 K, 303 K and 313 K.

Keywords: Modified APN membrane; Adsorption isotherm models; Nonlinear regression; Polyethyleneimine (PEI); Thermodynamic parameters

1. Introduction

Water contains various pollutants and several other substances are dissolved in it. Their concentration is useful for human body but in a specific limit. Fluoride, nitrate and sulfate are one of these pollutants in water and they have been recognized as one of the serious problems worldwide [1–4].

Several technologies have been proposed, in water treatment, for ions removal including ion exchange, reverse osmosis, nanofiltration, microbiological denitrification adsorption and chemical and biological methods etc. . . . [5–12]. Among them adsorption seems to be a more attrac-

tive method for fluoride, nitrate and sulfate removal in terms of cost, simplicity of design and operation. Different adsorbents have been tested for the removals of these ions from water. Adsorption on ion exchangers are considered to be highly stable and hence considered as one of the most promising adsorbents [4,10,13].

Extensive researches [14–20] have been done to study the adsorption of ions onto ion exchange resins and membranes. It was found that removal of ions using resins and membranes has a good potential for water treatment.

In fact, Sachin et al. [13] studied removal of nitrate by adsorption onto anion exchange Indian NSSR resin. Equilibrium isotherms were fitted using Langmuir, Freundlich and Dubinin–Radushkevich models. Obtained results showed that nitrate removal had followed the Langmuir

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PROGRAM OUTLINE

SUNDAY DECEMBER 17 , 2017

15:00-19:00	Registration
20:00	Dinner

MONDAY DECEMBER 18, 2017

8:00-9:00	Registration
9:00-10:00	Opening Ceremony <ul style="list-style-type: none">• Prof. Béchir Hamrouni, Tunisian Desalination Association President.• Official Opening : Minister of Ministry of Higher Education and Scientific Research• Prof. Miriam Balaban, General Secretary of European Desalination Society, Editor in Chief of the journal Desalination and Water Treatment.
10:00-10:40	Conference 1 : Prof. Jean François Fauvarque : incorporation of functional ceramics into polymers, in order to prepare ion selective membranes
10:40-11:10	Coffee break
11:10-11:50	Conference 2 : Raja Ben Amar : African Membrane Society activities
11:50-12:30	Conference 3 : Abdulmonem Ali Elhassadi : Performance experience history of general desalination company for the years 2016-2017
12:30-14:30	Lunch
14:30-16:10	Oral Communications Room "Forum" : Desalination processes Room "Utique" : Pre-treatment and post-treatment Room "Salambo" : Wastewater treatment
16:10-17:30	Coffee break/ Poster Session 1
20:00	Dinner

TUESDAY DECEMBER 19, 2017

9:00-9:40	Conference 4 : Philippe Haberschill : Energetic aspects of Water desalination
9:40-10:20	Conference 5 : Béchir Hamrouni : Boron : a problematic element in water desalination
10:20-10:50	Coffee break
10:50-12:50	Oral Communications Room "Forum" : Desalination processes/Energy for desalination Room "Utique" : Pre-treatment and post-treatment Room "Salambo" : Wastewater treatment
12:50-14:30	Lunch
14:30-16:00	Poster Session 2
16:00-16:30	Coffee break
20:00	Dinner

WENSDAY DECEMBER 20, 2017

10:00-11:00	Round Table & Closing session
12:00	Lunch

CMTDE	TITLE
CMTDE 2017_1	<i>Treatment of petroleum hydrocarbons-contaminated soil by advanced chemical oxidation.</i> Arrar Jazia et Moumed Imene
CMTDE 2017_2	<i>Etude des boues de la station d'épuration de Beni Messous (Algérie).</i> Nakib Mammam, Kettab Ahmed, Karef Salah, Benziaada Salim, Chabaca Nacer M, Benmamar Saadia, Boumalek Walid, Bouanani Hanane, Djillali Youcef
CMTDE 2017_3	<i>A physical Treatment Method as a Prevention Method For Barium Sulfate Scaling.</i> Salman M. A.; Al-Nuwaibit G., M. Safar, M. Rughaib and A. Al-Mesri
CMTDE 2017_4	<i>Clay minerals for fluoride removal from water: Kinetic modeling.</i> Guiza Sami
CMTDE 2017_5	<i>Proton exchange membranes based upon sulfonated polyethersulfone for electro dialysis applications.</i> Mabrouk W. ^{1,2,3,6} , Lafi R. ¹ , Charradi ³ , L. Ogier ⁵ , Sollogoub C. ⁶ , Matoussi F. ⁴ , Fauvarque J. F. ⁶ , Hafiane A. ¹
CMTDE 2017_6	<i>Experimental evaporation study of salt water Droplet Posed on different substrates.</i> Zouaghi Hiba, Harmand Souad and Ben Jabrallah Sadok
CMTDE 2017_7	<i>Energetic study of a solar-powered vacuum membrane distillation coupled with a liquid ring pump.</i> Frikha Nader
CMTDE 2017_8	<i>Acétylation de la cellulose en vue de l'élaboration d'une membrane.</i> AZAZI Fatima Zohra, BOUTOUMI Hocine, NACEUR Mohamed Wahib
CMTDE 2017_9	<i>Modeling adsorption in multicomponent system in industrial wastewater.</i> Laidi Maamar
CMTDE 2017_10	<i>A binderless monolith activated carbon from date stone : application as supercapacitor in water treatment.</i> Rezma Souad ^{1*} , Birot Marc ² , litaïem Yousra ³ Radhouane Chtourou ³ , Hafiane Amor ¹ , Deleuze Hervé ²
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CMTDE 2017_116	<i>Simple preparation of Er Doped Zinc Oxide Nanoparticles and their application in photocatalytic degradation of textile dyes under UV light irradiation. H. Chemingui^{1,2}, J. Chékir Mzali³, M. Kahloul¹, M. Smiri¹, M. Konyar⁴, H. C.Yatmaz⁵, A. Hafiane^{1*}</i>
CMTDE 2017_117	<i>Synthesis of reduced graphene oxide-polysulfone ultrafiltration nanocomposite membranes for water separation. AOUNI Anissa^{1*}, ALTINAY Aysegül Derya^{2,3}, KOSEOGLU- IMER Derya Y.^{3,4}, HAFIANE Amor¹, KOYUNCU Ismail^{3,4*}</i>

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CMTDE 2017_121	<i>Recovery of nickel ions by supported liquid membrane (SLM) extraction.</i> Othman Kemla ¹ , Ncib Sana ¹ , Bouguerra Wided ^{1,2} , Hamrouni Bechir ³ , Elaloui ELimam ^{1,2}
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CMTDE 2017_126	<i>Numerical study of a solar desalination system by Humidification-Dehumidification</i> SAIDI Sirine ^(a) , BEN RADHIA Rym ^(a,c) , BENHAMOU Brahim ^(b) , NAFIRI Naima ^(b) , BEN JABRALLAH Sadok ^(a,c)
CMTDE 2017_127	<i>Mineralization of the antihypertensive losartan in aqueous solution by Gamma Radiation</i> ZAOUAK Amira ^{1,2*} , NOOMEN Ahlem ¹ , JELASSI Haikel ¹
CMTDE 2017_128	<i>Nanoscale Zero-Valent iron functionalized-positonia oceanica marine biomass for heavy metals removal from water.</i> BOUBAKRI Saber ^{1,2} , DJEBBI Mohamed Amine ^{3,4,5*} , BOUZAZIZ Zaineb ³ , NAMOUR Philippe ⁵ , BEN HAJ AMARA Abdesslem ³ , GHORBEL-ABID Ibtissem ¹ , KALFAT Rafik ¹
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CMTDE 2017_130	<i>Performance evaluation of RO brackish water desalination unit</i> KAMOUN N.*, HABIBI N., BRAHMI O., ZENDAH H., ELFIL H.
CMTDE 2017_131	<i>Boron removal from aqueous solution by adsorption onto activated carbon and amorphous carbon</i> JAOUADI Mouna ¹ , HAMZAOUI Ahmed Hichem ¹ , DUCLAUX Laurent ² , REINERT Laurence ²
CMTDE 2017_132	<i>Towards sustainable desalination industry in Arab Region : Challenges and Opportunities</i> DAWOUD Mohamed A. ¹
CMTDE 2017_133	<i>Novel composite membrane based on recycled low-density polyethylene-alumina for membrane distillation</i> Ajari Hanen ^{1*} , Francesco Galiano ² , Tiziana Marino ² , Figoli Alberto ² , Zrelli Adel ¹ , Chaouachi Béchir ¹ , Pontie Maxime ³
CMTDE 2017_134	<i>Treatment of hardness on tunisian underground water by the new ballasted electroflocculation process</i> Brahmi Khaled ^{a*} , Bouguerra Wided ^a , Elaloui Elimame ^b , Hamrouni Béchir ^a
CMTDE 2017_135	<i>Treatment of heavy metals -polluted industrial wastewater by ballasted electroflocculation process</i> Brahmi Khaled a*, Bouguerra Wided a, Elaloui Elimame b, Hamrouni Béchir a
CMTDE 2017_136	<i>Seawater desalination and its impact on the environment</i> ZENDAH Houda, MARS Abdelmoneim, ELFIL Hamza
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CMTDE 2017_138	<i>Optimization of dyes Removal by Adsorption onto Activated Carbon</i> TRIFI B. ¹ , MARZOUK TRIFI I. ² , BOUALLEGUE M.C. ¹ , HAMROUNI B. ²

CMTDE 2017_139	<i>Nickel removal from wastewater by electrocoagulation using aluminium electrodes : Effect of lectrocoagulation parameters</i>
CMTDE 2017_140	<i>Separation of copper(II), chromium(III) and nickel(II) from nitric solutions by polymer inclusion membrane</i> NCIB S. ^{a,c} , BARHOUMI A. ^a , BOUGUERRA W. ^{a,b*} , LARCHET C. ^c , DAMMAK L. ^c , HAMROUNI B. ^b , ELALOUI E.
CMTDE 2017_141	<i>Chromium removal by adsorption on orange peels: optimization of influencing parameters</i> ¹ RZIG Boutheina, ^{1,2} BEN KHALIFA Eya, ² NEHDI Houda, ² NOUAIGUI Hbib, ¹ HAMROUNI Béchir
CMTDE 2017_142	<i>Application of response surface methodology for the speciation of cadmium in natural waters using cloud point extraction</i> HSAINI Jaber ^a , NAFTI Mariem ^b , HANNACHI Chiraz ^a , GUESMI Fatma ^a and HAMROUNI Béchir ^a
CMTDE 2017_143	<i>Speciation of mercuric ions from natural waters by cloud point extraction : evaluation and optimization using central composite design</i> HSAINI Jaber ^a , HANNACHI Chiraz ^a , NAFTI Mariem ^b , GUESMI Fatma ^a and HAMROUNI Béchir ^a
CMTDE 2017_144	<i>Removal of boron from geothermal water by reverse osmosis and adsorption onto activated charcoal originated from palm bark: experimental design and breakthrough curves modeling</i> KHERIJI Jamel, MELLITI Abir, BESSAIES Hanen, HAMROUNI Béchir
CMTDE 2017_145	<i>Equilibrium Modeling for Adsorption of Aqueous Phenol Onto Activated Carbon: Linear versus Nonlinear Regression Analysis.</i> TABASSI Dorra, HARBI Soumaya, LOUATI Islem, HAMROUNI Béchir
CMTDE 2017_146	<i>Adsorption of cadmium from aqueous solution by bioadsorption using a marine plant, Posidonia oceanica: Kinetics, equilibrium, and thermodynamics.</i> BESSAIES Hanen, KHERIJI Jamel, HAMROUNI Béchir
CMTDE 2017_147	<i>Optimization of a new method for Nickel dosage in industry effluents water using ET-AAS</i> Mariem NAFTI ^{a,b*} , Chiraz HANNACHI ^b , Radhouane CHAKROUN ^a , Arbia DOUGARI ^a , Bechir HAMROUNI ^b , Habib NOUAÏGUI ^a .
CMTDE 2017_148	<i>Cation exchange membrane having permselectivity for monovalent ions : Effect of temepeature on ion exchange equilibrium.</i> CHAABOUNI Akrem*, GUESMI Fatma, HANNACHI Chiraz, HAMROUNI Béchir
CMTDE 2017_149	<i>Equilibrium modeling of single and binary adsorption of Cr(VI) and phenol onto Dowex 1X8 ion exchange resin : Kinetic and thermodynamic study</i> HARBI Soumaya, TABASSI Dorra, HANNACHI Chiraz, GUESMI Fatma and HAMROUNI Bechir
CMTDE 2017_150	<i>Application of response surface methodology for chromium removal by biosorption.</i> ^{1,2} BEN KHALIFA Eya, ¹ RZIG Boutheina, ¹ HAMROUNI Béchir
CMTDE 2017_151	<i>Application of a low cost adsorbent for boron removal</i> ^{1,2} BEN KHALIFA Eya, ¹ RZIG Boutheina, ¹ HAMROUNI Béchir
CMTDE 2017_152	<i>Use of electrodialysis to remove cadmium from water Using Response Surface Methodology.</i> HANNACHI Chiraz*, LOUATI Islem*, HABIBI Amira*, GUESMI Fatma* and HAMROUNI Béchir*
CMTDE 2017_153	<i>The optimization of a simulation study on an AGMD membrane distillation unit and the experimental validation for desalination of seawater or brackish water</i> KHMILI Sofiene ¹ , BOUKHRISS Mokhless ² , MEJBRI Sami ² and BEN BACHA Habib ^{2,3}
CMTDE 2017_154	<i>Response surface methodology for optimization of boron adsorption by activated carbon: Isotherm and Kinetics study</i> LOUATI Islem, GUESMI Fatma, HANNACHI Chiraz, HAMROUNI Béchir
CMTDE 2017_155	<i>Application of response surface methodology for boron removal from water by Electrodialysis</i> GUESMI Fatma ^{1,*} , LOUATI Islem ¹ , HANNACHI Chiraz ¹ , HAMROUNI Béchir ¹
CMTDE 2017_156	<i>Effect of physico-chemical parameters on the interaction between methylene blue and poly(acrylamide-co-styrene-co-2-acrylamido-2-methylpropane sodium sulfonate)</i> ZARROUG Sondess, JEMILI Nouha, BEN MAHMOUD Souha, RAWISO Michel, HAMZAOUI Ahmed Hichem ^d , ESSAFI Wafa ^{a,*}



CMTDE 2017_157	<i>Experimental study of membrane distillation feasibility for sea water desalination</i> LOUATI Rami, BEN JABRALLAH Sadok
CMTDE 2017_158	<i>Treatment of textile releases by membrane techniques. Study of clogging and the unclogging</i> BOUGHDIRI Aouatef ¹ , FERJANI Ezzedine ²
CMTDE 2017_159	<i>Natural zeolite for elimination of fluoride from drinking water</i> TURKI Thouraya ^{1,2} , BEN AMOR Mohamed ¹
CMTDE 2017_160	<i>Boron removal from water by adsorption onto activated carbon (prepared from Palm Bark) in batch process and fixed bed column</i> MELLITI Abir, KHERIJI Jamel, BESSAIES Hanen, HAMROUNI Béchir
CMTDE 2017_161	<i>Once-through multistage flash desalination process combined with thermal vapor compression</i> MSF-OT/TVC SELLAMI Ahlem ^{1*} , BEN ALI Mongi ^{2*} , LAKHDAR Mouna ^{3*} , KAIROUANI Lakdar ^{4*}
CMTDE 2017_162	<i>Improvement of performance indicators of multistage flash desalination plant</i> BEN ALI Mongi ^{1,2} , KAIROUANI Lakdar ²
CMTDE 2017_163	<i>Purification of the waste water by coagulation – flocculation treatment of the city of Annaba (east of Algeria)</i> N. LASKRI ¹ , N. NEDJAH ¹ , D. DAAS ² and M. BACCOUCHE ¹
CMTDE 2017_164	<i>Production du bioéthanol par fermentation alcoolique d'une biomasse riche en sucre : Opportunité énergétique et environnementale</i> N. NEDJAH ¹ , N. LASKRI ¹ , D. DAAS ² et M. BACCOUCHE ¹

TREATMENT OF PETROLEUM HYDROCARBONS-CONTAMINATED SOIL BY ADVANCED CHEMICAL OXIDATION

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ABSTRACT

Remediation of soils polluted by petroleum hydrocarbons is a very interesting topic in environmental research, several techniques have been used and others are in development. Advanced oxidation technologies have received increasing attention recently, for their significant effectiveness on various recalcitrant organic pollutants destruction. Among these technologies, we are interested in Fenton-like oxidation because of its application at neutral pH favored for indigenous microorganisms' development for eventual biodegradation. The present study aims to investigate the influence of hydrogen peroxide, iron zero-valent contents and chelating agent presence on petroleum hydrocarbons degradation efficiency by Fenton-like oxidation is evaluated. For this effect, we follow the temporal evolution of total petroleum hydrocarbons (TPH) , the pH change , and the humidity was kept constant during the treatment period . Contaminated soil was collected, according to AFNOR X31-100, from a site with a history of petroleum contamination over a period of years , located at 36° 11'26,01 North , 3° East 11'08,0 in Dar El Beida to the east of Algiers. The soil samples were taken a depth of 0-20cm. to the east The soil was air dried at room temperature, sieved at 0.8mm, homogenized according to the quartering method, this method being repeated twice, and then stored at 4°C until used. Table 1: Soil chemical characteristics pH 7.21 Clay (%) 15 Hu(%) 2.46 Silt (%) 35.75 MO(%) 5.97 Sand (%) 49.75 CO(%) 2.08 ρ (m/s) $5.56 \cdot 10^{-5}$ D10 (μm) 15 Texture Sandy loam D60 (μm) 160 Cu (D60/D10) 10.66 Porosity 0.41 Iron (Fe) (%) 1.68 Our processing relates to abiotic systems, by varying the hydrogen peroxide content and only based on the amount of iron that exists originally in soil, after choosing optimal hydrogen peroxide content, we set the hydrogen peroxide content and we varied the iron content , and finally the contents is fixed to hydrogen peroxide and iron and varying the content of the chelating agent (EDTA). The reactors are under conditions of ambient temperature, neutral pH, protected from light to avoid photo-oxidation phenomenon and stirring of 150 rd / min throughout the treatment. Based on the amount of iron that is originally in the soil removal efficiency of the TPH reaches its maximum at a value of 21% to a molar ratio H_2O_2 :Fe of 15:1. Therefore the non-effectiveness Fenton oxidation processing using hydrogen peroxide can only be explained by the high contamination level. After adding different amounts of iron, the performance of optimal elimination was of 40% for optimum molar ratio H_2O_2 : Fe of 15:4. The addition of a quantity of iron slightly improved performance of elimination, but chelating agent (EDTA) introduction in the last part, played an important role in maximizing iron catalytic activity and achieve removal petroleum hydrocarbons rate of 73% in preventing its precipitation, so reducing efficiency Fenton-like processing.

KEYWORD : Fenton-like, EDTA, petroleum hydrocarbon, soils remediation, advances oxidation

ÉTUDE DES BOUES DE LA STATION D'EPURATION DE BENI MESSOUS (Algérie)

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RESUME

En Algérie, les réserves organiques des sols ont subi plusieurs transformations sous la contrainte d'utilisation intensive des ressources naturelles. Le stockage du carbone dans le sol est une des alternatives avancées afin d'atténuer les émissions de gaz à effet de serre et d'améliorer la fertilité du sol. L'utilisation des boues d'épuration sur le sol agricole permet, en dehors de l'apport de fertilisants, de préserver la fragilité écologique des sols algériens déjà soumis à une dégradation intense. Les boues d'épuration constituent un potentiel de matières organiques et d'éléments fertilisants, mais elles peuvent être également une source de pollution.

L'étude doit estimer le pouvoir fertilisant, la richesse en MO des boues ainsi que les risques liés aux métaux lourds, en fixant les doses limites à ne pas dépasser dans le respect de l'environnement.

Les boues issues de la station d'épuration de Beni Messous, avec une capacité épuratoire de 250 000 Eq.Hab, sont issues du traitement biologique des eaux usées urbaines.

Le dosage du carbone des sols de la région laisse apparaître des taux de matière organique assez bas. La teneur moyenne en matière organique des sols est de 1,3 % et la valeur minimale de 0,2% vient conforter notre démarche pour un apport de matière organique par une source extérieure : les boues d'épuration.

Les boues contiennent des quantités appréciables d'éléments fertilisants :

La quantité de MO apportée pour une dose de 10T/ha de boue apporte : 4,8tonne de MO, 230 kg d'azote, 280 kg de phosphore et 6 kg de potassium, le potassium, très soluble demeure dans les eaux épurées. Les teneurs en métaux lourds des boues d'épuration de la station d'épuration de Beni Messous sont très élevées et dépassent souvent la norme NF U44-051. Notre étude montre que le cadmium constitue les facteurs limitant les plus restrictifs pour l'utilisation des boues d'épuration dans l'agriculture. Le cadmium limite l'utilisation de ces boues à 6,43T/ha.an et cette dose ne représente que 60 % de la quantité nécessaire pour améliorer le sol, l'utilisation d'une autre source d'amendement organique étant indispensable. Pour compenser ce déficit, nous recommandons d'utiliser les boues en mélange avec du compost urbain ou du fumier de ferme. En effet, la composition des déchets urbains au niveau de la région est très favorable à ce genre de pratique (teneur en eau élevée, teneur en matière organique élevée, PCI (pouvoir calorifique faible).

Cela nous permettra d'aboutir à une formule plus équilibrée et mieux adaptée dans le cadre de l'amendement organique où l'humus joue un rôle incontournable dans la fertilité des sols dans une perspective de respect de l'environnement.

MOTS CLES: traitement eaux usées, boues d'épuration, fertilisants, métaux lourds.

A PHYSICAL TREATMENT METHOD AS A PREVENTION METHOD FOR BARIUM SULFATE SCALING

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ABSTRACT

Barium sulfate ($BaSO_4$) is a hard scaling usually precipitates on the surface of equipments in many industrial systems, as oil and gas production, desalination and cooling and boiler operation. It is a scale that extremely resistance to both chemical and mechanical cleaning. So, $BaSO_4$ is a problematic and expensive scaling. Although barium ions are present in most natural waters at very low concentration as low as 0.008 mg/l, it could result of scaling problems in the presence of high concentration of sulfate ion or when mixing with incompatible waters as in oil produced water. The scaling potential of $BaSO_4$ using seawater at the intake of seven desalination plants in Kuwait, brine water and Kuwait oil produced water was calculated and compared then the best location in regards of barium sulfate scaling was reported. Finally a physical treatment method (magnetic treatment method) and chemical treatment method were used to control $BaSO_4$ scaling using saturated solutions at different operating temperatures, flow velocities, feed pHs and different magnetic strengths. The results of the two method were discussed and the more economical one with reasonable performance was recommended, which is the physical treatment method.

KEYWORDS : Magnetic field strength, flow velocity, retention time.

CLAY MINERALS FOR FLUORIDE REMOVAL FROM WATER : KINETIC MODELING

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ABSTRACT

This experimental study deals with the adsorption of fluoride on natural and activated clay minerals in agitated batch adsorber. The effect of agitation, initial fluoride concentration and mass of adsorbent and were investigated. It appears that the rate of fluoride removal increased with the agitation speed and mass of adsorbent but it decreases with the initial fluoride. Five models for external transport were used to calculate the external mass transfer coefficient, k_f , and the results showed that this coefficient is in the range of 10^{-5} - 10^{-4} ms^{-1} .

KEYWORDS: Clay minerals, Fluoride, Adsorption, Kinetic modeling, External mass transport processes.

PROTON EXCHANGE MEMBRANES BASED UPON SULFONATED POLYETHERSULFONE FOR ELECTRODIALYSIS APPLICATIONS

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ABSTRACT

In this research work, the Synthesis and characterization of new ion exchange membranes made from chlorosulfonated polyethersulfone (SO₂Cl-PES) crosslinked by polyaminated crosslinking reagents have been performed. Chlorosulfonated polyethersulfone (SO₂Cl-PES) and NH₂-PES have similar chemical structures that allow compatibility. The best results have been obtained using SO₂Cl-PES with 1.3 SO₂Cl group per monomer unit crosslinked by 0.2 equivalent of NH₂-PES.

The membranes synthesized by this approach were completely transparent and homogeneous and less brittle than pristine SPES and insoluble in solvents such as DMAc. She is called CINH₂, were characterized by TGA, DMA, DSC, ionic conductivity, transport numbers, and water swelling. The results showed that these membranes presented very promising performances for use in Electrodialysis applications.

KEYWORDS : Ionic conductivity, Crosslinked sulfonated polyethersulfone, Proton exchange membrane fuel cell, electrodialysis.

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EXPERIMENTAL EVAPORATION STUDY OF SALT WATER DROPLET POSED ON DIFFERENT SUBSTRATES

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ABSTRACT

This study deals with the evaporation of salt water droplet having a NaCl concentration of 0.01% posed on different substrates. The initial volume of the droplet is fixed on 10 μ l at an ambient temperature of 18°C. The air around droplet is heated to 30°C in average, with heat flux about 8000W/m². The droplet is posed on five substrates which are Aluminum, stainless steel, carbon, glass and PTFE (polytetrafluoroethylene). The assembly is posed on sensitive balance to measure droplet mass during the time. The variation of evaporated mass flow during the time is determined for the different substrates. It decreases as function of time and it is maximum at the beginning of evaporation process. It is also influenced by the substrate on which it's posed. The device is exposed to an infrared camera. It indicates the temperature of droplet surface for different substrates during the evaporation process. The variation of evaporated mass flow is related to the temperature of the surface droplet. The variation of the diameter of the droplet is deduced from temperature profile; its variation depends on the nature of substrate on which it's posed.

KEYWORD : evaporation, droplet, substrate, flow, diameter.

ENERGETIC STUDY OF A SOLAR-POWERED VACUUM MEMBRANE DISTILLATION COUPLED WITH A LIQUID RING PUMP

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ABSTRACT

Today, humanity faces great challenges on energy, economy and environment. So, there is a strong need to better design, analyze and evaluate energetically processes, systems and applications. Well-established energy research in desalination has helped in the decrease of water treatment costs. On the other hand, the lack of fresh water is considered as a serious problem that is constantly increasing, due to the population growth and changes in weather conditions. Desalination using solar energy coupled with membrane technology is considered an attractive alternative to the production of drinking water. Membrane distillation (MD) is a new technology that combines distillation and membrane separation. MD is characterized by a lower operating temperature than the typical distillation and lower operating hydrostatic pressures than the pressure-driving process. Furthermore, the operating temperature of the MD process is in the range of 60-80°C, at which the thermal solar collectors perform well. In this work, we are interested in VMD technology, which is an evaporative process using a hydrophobic porous membrane, whose function is to separate a liquid phase from a gas one. In VMD, the choice of condensation and vacuum creation systems is an important issue. The conventional solution is to couple a condenser or a heat pump with a vacuum pump. But, the most modern solution is the vacuum liquid ring pump. This liquid ring pump has a dual functionality: condensation and vacuum creation. In this work, a VMD plant coupled with solar energy using a liquid ring pump was studied. The operation of hollow fiber module and the liquid ring vacuum pump was simulated by programs developed in the MATLAB codes. These programs are based on mass and heat transfer within the hollow fiber module and the liquid ring vacuum pump. The global model developed allowed us to perform a parametric study that quantifies the influence of different parameters on the energy performance of the system. Among the studied parameters, we include the influence of vacuum pressure applied, the inlet feed flow rate and the auxiliary fluid flow rate on the specific energy consumption C_{sp} . The study demonstrated that the enhancement or reduction of energy losses will be mainly by recovering heat lost in brine discharges and by reducing the flow rate of the auxiliary fluid supplying the liquid ring pump. This study has shown that the use of a liquid ring pump is energetically more efficient than the use of a vacuum pump coupled with a condenser.

KEYWORDS : Desalination, Energetic study, VMD, Liquid ring vacuum pump

ACÉTYLATION DE LA CELLULOSE EN VUE DE L'ÉLABORATION D'UNE MEMBRANE

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RÉSUMÉ

Les préoccupations croissantes existent aujourd'hui au sujet de la préservation des systèmes écologiques. Cependant, aujourd'hui, la plupart des polymères de synthèse sont produits à partir de la pétrochimie et rarement biodégradable. L'utilisation persistante de polymères constitue une source importante de pollution environnementale, de nuire à la conservation des espèces sauvages lorsqu'ils sont dispersés dans la nature [1]. Par exemple, l'élimination des sacs en plastique non dégradables affecte négativement la vie de mer.

La cellulose est le polymère naturel le plus abondant sur la terre synthétisé par la photosynthèse de monde végétale, possédant une structure macromoléculaire polyfonctionnel et le respect de l'environnement. La cellulose est caractérisée par sa grande linéarité, une bonne flexibilité, une excellente durabilité, chiralité, biodégradabilité, résistance chimique et mécanique, non-toxicité et le faible coût, mais il souffre du manque de solubilité dans la plupart des solvants organiques émanant de son architecture supramoléculaire. Cependant, l'un de ses dérivés organosoluble l'acétate de cellulose est affiché une bonne solubilité dans les solvants organiques, créant ainsi l'exposition de la capacité à former une membrane appropriée et modérée [2-3].

La modification chimique des polymères est une stratégie efficace pour générer de nouveaux matériaux avec une ou des propriétés physiques et chimiques. L'acétylation est largement utilisée en chimie organique et polymères pour améliorer la solubilité dans les solvants non-polaires. L'intégration de groupe organoacétyle est connue pour modifier les propriétés thermiques, mécaniques et les propriétés de surface des polymères [4].

Objectif de notre travail est la valorisation d'un biopolymère qu'est la cellulose en synthétisant un dérivé cellulosique qu'est l'acétate de cellulose avec des différents degré de substitution via une acétylation en utilisant l'anhydride acétique. On ajuste les paramètres expérimentaux influençant la réaction acétylation (température, temps de réaction, rapport (anhydride acétique /cellulose)), ainsi de caractériser le polymère préparé, après avoir préparé une série des membranes.

MOTS CLÉS : Biopolymère, Acétate de cellulose, Acétylation, Membrane.

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MODELING ADSORPTION IN MULTICOMPONENT SYSTEM IN INDUSTRIAL WASTEWATER

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ABSTRACT

Heavy metals elimination from aqueous solutions has been a focus area of research in recent years. Many technologies have been developed for removing this kind of pollution but adsorption is generally chosen since it is considered as one of the most useful and economical techniques used to remove heavy metals from water. In this study, nine multicomponent isotherm models as well as one new proposed model were used to model the removal of Cd^{2+} , Cu^{2+} , Ni^{2+} and Pb^{2+} from multi-metal ion aqueous solutions using natural Ca-bentonite was studied. Experimental adsorption data were obtained for literature as quaternary mixtures. The coefficients of these models were obtained by coupling two optimization methods: genetic algorithm with optimization algorithm by adjustment of the least squares curves (Matlab code: GA-Lsqcurvefit). To validate the proposed model, the adsorption values predicted by this equation for the quaternary system charged with heavy metals were compared to values determined experimentally. Results show that the proposed model is the most suitable for describing kinetics of the selected multi-component system adsorption after Langmuir and Freundlich isotherm, which was explained by the absolute average relative deviation (AARD) 17.56% and a coefficient of regression 0.8009 for proposed mode I.

KEYWORDS : Multicomponent ; Adsorption ; Model ; Isotherm

A BINDERLESS MONOLITH ACTIVATED CARBON FROM DATE STONE : APPLICATION AS SUPERCAPACITOR IN WATER TREATMENT

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ABSTRACT

Microporous activated carbon pellets have been prepared from date stone without the use of binder. These pellets were tested as super-capacitor. The activation process involved two steps. First a pyrolysis of the samples was conducted to a temperature of 1000°C under nitrogen flow. The obtained carbon monoliths were then physically activated at 900°C under CO₂ flow. BET, SEM, ATG/ATD, mercury porosimetry and electrochemical performance testing carried out to characterize the structure and proprieties of activated carbon pellets. The activated carbons exhibited predominant microporosity with specific surface area of 896 m².g⁻¹ which leads to the highest specific capacitance 541.18F/g. The performance of ACP900 electrode in CDI test was examined and leads to an important result.

KEYWORD : binderless activated carbon, physical activation, monolith, supercapacitor, CDI

MONITORING THE GROWTH OF MARINE BIO-FILMS OF DIFFERENT METALLIC ALLOYS IN SEAWATER BY ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

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ABSTRACT

The main purpose of this study was to monitor the growth of the marine bio-film, of micro/macro-organisms, on the surface of different metallic alloys in seawater by electrochemical impedance spectroscopy (EIS). The alloys used in this study were; sanicro 28, stainless steel 316L, Cu–Ni 70–30, and titanium. The EIS was used in order to measure the charge transfer resistance (R_{ct}) of the alloys in seawater on a frequent basis. The total exposure time of the tests was about 180 days. The visual inspection of the tested samples showed a bio-film formation on the surface of these samples. Monitoring the growth of the bio-film formation was accomplished by the EIS during the 180 days exposure of the tested samples. A gradual monitoring the growth of the bio-film formation was achieved by mathematically correlating the obtained charge transfer resistance (R_{ct}) of the alloys to the thickness of the bio-film formation.

KEYWORDS : Marine bio-film; Electrochemical impedance spectroscopy; Seawater; Charge transfer resistance.

GREEN SYNTHESIS OF ZINC OXIDE (ZNO) NANOPARTICLES FROM LAURUS NOBILIS PLANT EXTRACT : OPTICAL PROPERTIES AND THEIR ANTIBACTERIAL ACTIVITY

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ABSTRACT

The present study involves green synthesis of ZnO nanoparticles (Nps) using aqueous Laurus Nobilis plant extract as capping agent. The obtained ZnO Nps were characterized by UV–Vis spectroscopy, Photoluminescence (PL), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscope (SEM) analysis. The extract was found to contain reducing components such as polyphenols (22.5%) and flavonoids (21%). Powder XRD studies indicate the formation of pure Wurtzite structure. The synthesized ZnO NPs was characterized by a peak 375 nm in the UV- Vis spectrum. FTIR confirmed the presence of functional groups of both leaf extract and ZnO NPs. Photoluminescence study reveals the blue emission at 402, 447, 469 and 483 nm and the green emission at 529 nm respectively. In addition, the synthesized NPs are wurtzite hexagonal structure with an average grain size lies between 20 and 50 nm were found from XRD analysis. The antibacterial activity of ZnO NPs was investigated against Escherichia coli by using agar dilution method. The minimum inhibitory concentration value of the ZnO nanoparticles was found to be 1200µg/ml for E.coli. The results show that the ZnO NPs Biosynthesized, as a kind of antibacterial material, had a great promise for application in a wide range of biomedical applications. We suggested that plants represent an important bio resource of ZnO (Nps).

KEYWORDS : Green synthesis, optical properties, ZnO nanoparticles, Laurus nobilis extract, Antibacterial activity, E. coli.

CARTOGRAPHIE DE LA VULNERABILITE DU BASSIN SEBKHA D'ORAN

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RÉSUMÉ

Le bassin sebkha d'Oran à vocation agricole, avec un climat aride à semi-aride. Les eaux souterraines servent à l'alimentation en eau potable de la population et à l'irrigation. La qualité de ces eaux dépend de divers facteurs naturels et anthropiques. Un certain nombre de points dans le bassin, sont sous l'influence du drainage des eaux usées de l'agglomération et des douars environnants. L'évaluation de la gravité de la contamination des eaux souterraines dans le bassin sebkha d'Oran par les nitrates doit, tenir compte à ce qui se passe en surface.

L'agriculture est responsable en majeure partie de la pollution par les nitrates en milieu rural agricole, certaines pratiques comme la super fertilisation des champs et les écoulements en provenance des tas de fumier sont faciles à identifier comme sources des nitrates.

La cartographie des zones vulnérables à la pollution pourrait aider les gestionnaires du secteur de l'hydraulique pour mieux gérer cette ressource hydrique en la protégeant contre la pollution et également les aider à implanter les ouvrages de captage en dehors des zones contaminées. L'objectif visé par l'établissement de la cartographie de la vulnérabilité est de faire apparaître les possibilités de pénétration et de circulation des polluants dans la nappe. On peut aussi évaluer la sensibilité des ouvrages de captage au risque de pollution et par conséquent le limiter.

MOTS CLÉS : Sebkhha d'Oran, Cartographie, Nitrate, ArcGis.

SYNTHESIS AND APPLICATION OF LDH INTERCALATED CELLULOSE NANOCOMPOSITE FOR SEPARATION OF ARSENATE AND ARSENITE

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ABSTRACT

Present study deals with the synthesis of two new materials CL-Zn/Al LDH and CL-Ca/Al LDH nanocomposite. The CL-Zn/Al LDH and CL-Ca/Al LDH were characterized by XRD, FTIR, EA, BET, TEM, RMN and AFM. XRD analysis represented the crystalline nature of LDH nanocomposite and TEM analysis approved the formation of a sheet like structure of LDH for both sorbent. Investigation of arsenite (As(III)) and arsenate (As(V)) onto CL-Zn/Al LDH and CL-Ca/Al LDH nanocomposite from aqueous water at initial pH showed that the adsorption kinetics and equilibrium data described, respectively, the pseudo-second order equation ($R^2 = 0.99$), the Freundlich and Dubinin-Astakhov isotherms ($R^2 \geq 0.99$) very well. Beside l'analysis of thermodynamic studies for As(III) and As(V) over CL-Zn/Al LDH and CL-Ca/Al LDH illustrated that the process of adsorption is spontaneous and endothermic in nature. It could be motionned that Zn/Al Layered double hydroxide (LDH) intercalated cellulose (CL) nanocomposite is more effective for As(III) removal compared CL-Ca/Al LDH nanocomposite.

KEYWORDS : Layered double hydroxide, Adsorption, Arsenic removal, Kinetics.

NIGELLA SATIVA L. SEEDS BIOMASS AS A POTENTIAL SORBENT IN SORPTION OF LEAD FROM AQUEOUS SOLUTIONS AND WASTEWATERS

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ABSTRACT

Every year millions tons of biomasses issues from agriculture activities and food factories are discarded as a waste. These bulk vegetal biomasses constitute a potential and promoting material in heavy metal pollutants remediation. This first study investigated the efficiency removal of Pb(II) from solution and wastewater effluents using *Nigella sativa* seeds waste biomass. The experiments were performed in batch mode under various parameters such as contact time, initial Pb(II) concentration, initial pH and biosorbent dose. The biosorption data was analyzed using pseudo-first and pseudo-second-order kinetic models of Langmuir and Freundlich isotherms. The sorbent was characterized by FTIR. The optimal conditions such as equilibrium contact time for the removal of Pb(II), amount of adsorbent dose and pH were 360 min, 0.07 g and pH > 4. Under these conditions, the corresponding response for maximum biosorption yield was 90.31 mg/g. The Langmuir model and pseudo-second order kinetic fitted well to the adsorption experimental data. The successfully removing trial of lead from activated sludge waste and its decanted effluent was also confirmed under the above mentioned conditions and the sorption efficiency attain 97% and 64% respectively. Based on the results, the *Nigella sativa* seeds waste biomass appears as a promising biosorbent for remediation of lead pollutant from wastewaters.

KEYWORDS: *Nigella* seeds meals waste ; Biosorption ; Biomass sorbent ; Heavy metal pollutants ; Lead removal ; Wastewater.

NEW APPROACH OF COST MAINTENANCE EVALUATION FOR THE MULTI STAGE FLASH

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ABSTRACT

This study aims to develop a service model based on the influential factors to minimize maintenance costs and increase production. The modeling of MSF process, which allowed the application of the concepts of the factors of reliability, maintainability and availability, based on mass and energy balances. It showed that the availability of the MSF process depends mainly on the availability of each stage which is also dependent on the pumps installed in each stage in parallel or serial way. The study provides an overview on different factors and their role in the maintenance strategy applied to maintain the equipment in good operating condition. Finally the objective is to achieve a desired annual production with a minimal operating cost and therefore find a better compromise (reliability / price) to satisfy a good and a suitable operation of the process.

KEYWORDS : Model, MSF, maintenance, operating cost, production, reliability.

FIXED BED ADSORPTION COLUMN STUDIES FOR THE REMOVAL OF AQUEOUS AMOXICILLIN FROM ACTIVATED CARBON PREPARED FROM PEDICELS OF DATE

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ABSTRACT

Fixed bed adsorption has become a frequently used industrial application in wastewater treatment processes. Various low cost adsorbents have been studied for their applicability in treatment of different types of effluents. In this study, the potential of activated carbon derived from pedicels of date was studied for the removal of aqueous amoxicillin in a fixed column. Pedicels of date were activated chemically, then carbonized under 500°C in a Muffle oven. A series of batch experiments were performed in order to identify the appropriate adsorption isotherm. Both Langmuir and Freundlich equilibrium isotherms were analyzed according to the experiment data and related parameters were estimated. Fixed bed experiments were performed and, breakthrough curves were drawn by varying activated carbon bed height, initial concentration of pollutant, and flow rate. Accordingly the ideal breakthrough curves (IBC) were prepared and bed capacity (BC), length of the unused bed (LUB), the time required for full bed exhaustion at infinite rapid adsorption TS and the breakthrough times Tb were calculated for each case.

KEYWORDS : Fixed bed, Adsorption, Amoxicilline, water pollution

ADSORPTION OF ANIONIC DIRECT YELLOW (DY9) DYE ONTO NATURAL UNTREATED CLAY (NUC) FROM AQUEOUS PHASE – USE OF DOEHLERT DESIGN FOR OPTIMIZING PROCESS CONDITIONS

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ABSTRACT

Reactive adsorption of direct yellow (DY9), an anionic dye, using clay materials, smectite from GUELMA deposits (Algeria), clay has been selected as an adsorbent because of advantages such as high adsorption capacity, potential of variety of pollutants removal, non toxicity, availability, low cost and high rate of adsorption.

Natural untreated clay (NUC) was characterized by X-ray diffractometry (DRX), Fourier-Transform–Infrared spectroscopy (FT–IR), and surface area (BET) analyses. The optimization process was carried out using Doehlert matrix designs. Five variables (pollutant concentration $[DY9]_0=100-200 \text{ mg.L}^{-1}$, $\text{pH}=2-7$, adsorbent dosage $[\text{clay}] = 20-50 \text{ g.L}^{-1}$, temperature $T=15-45^\circ\text{C}$, stirring rate $V = 200-400 \text{ rpm}$) were studied. The accuracy of the model and regression coefficients were appraised by employing the analysis of variance (ANOVA). The foregoing results obtained by response surface methodology led to the following optimal conditions for dye adsorption: pollutant concentration $[DY9]_0$ of 125 mg L^{-1} , pH of 3,4, adsorbent dosage $[\text{clay}] = 35 \text{ g.L}^{-1}$, temperature $T= 30^\circ\text{C}$, and stirring rate $V = 300 \text{ rpm}$, which gave a decolorization rate of 97.6 %. Response surface methodology modeling results indicated that the adsorption of DY9 by NUC was highly affected by the initial pH value and the adsorbent dosage.

Predicted values were found to be in good agreement with experimental values and as a result reflected the precision and the applicability of Response Surface Methodology (RSM) ($R^2=0.9427$ and $\text{Adj } R^2= 0.8569$)

KEYWORDS : clay, adsorption, RSM, Doehlert matrix, Optimization.

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EFFECT OF NANOFUIDS ON THE PERFORMANCE OF A SOLAR STILL WITH AND WITHOUT HEAT EXCHANGER 'COMPARISON STUDY'

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ABSTRACT

This present paper studies and compares the effect of different nanofluids Aluminum Oxide (Al_2O_3), Zinc Oxide (ZnO), basefluid 'water' on the performance of a double effect solar still with and without heat exchanger for climatic conditions of Ouargla city 'south of Algeria' $31^{\circ} 56' 57$ N latitude and $5^{\circ} 19' 30$ E longitude.

The use of nanofluids and heat exchanger are beneficial to enhance the heat transfer in the still case to improving system performance, also the water flowing over the glass cover of the first effect of the still shows a good effect on the productivity of the solar still by decreasing the temperature of glass cover. Further, the influence of some factors of climatic, operational, and design parameters on the productivity of solar still was investigated.

Results showed that the performance could increase remarkably with Aluminum Oxide (Al_2O_3) than Zinc Oxide (ZnO) and base-water with different parameters , however the integrating a heat exchanger in the still improves more the productivity of the system of the still than without a heat exchanger. Finally the results of the investigation are useful for optimization of the various parameters of the proposed system for optimal performance.

KEYWORDS : solar still ; Nanofluid ; heat exchanger ; performance

CONTAMINATION DE LA BAIE D'ANNABA (EXTREMITE NORD-ORIENTALE DE L'ALGERIE) PAR LES MULTI-RESIDUS DE PESTICIDES

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RÉSUMÉ

La baie d'Annaba constitue l'ultime récepteur d'innombrables substances chimiques issues des diverses activités anthropiques. Ces rejets telluriques sont potentiellement accompagnés de composés chimiques à caractère biocide.

En vue de conserver la qualité des eaux littorales et limiter ces flux dangereux pour l'environnement marin, un suivi saisonnier de la qualité des eaux des deux principaux oueds, qui constituent les principales sources de pollution des eaux littorales, a été réalisé.

Les résultats montrent que l'oued Bouhamra est principalement pollué par les insecticides organochlorés et organophosphorés, les herbicides et les fongicides. Tandis que l'oued Seybouse est majoritairement altéré par les insecticides organophosphorés, les herbicides et les fongicides. La qualité des oueds est très mauvaise à médiocre vis-à-vis des insecticides organochlorés, organophosphorés et herbicides. Une qualité passable est attribuée aux eaux par rapport aux fongicides.

MOTS CLÉS : multi-résidus de pesticides – pollution organique – eaux superficielles – oueds Bouhamra et la Seybouse – baie d'Annaba, Algérie.

VALORIZATION OF AGRICULTURAL WASTE (PEDICELS OF DATE) INTO ACTIVATED CARBON FOR THE EMERGENT POLLUTANT (AMOXICILLIN) ELIMINATION FROM CONTAMINATED WATER

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ABSTRACT

This article deals with the preparation and characterization of activated carbon from agricultural waste (Pedicels of date), which is a very abundant material in Algeria, and some countries. It is to elucidate the chemical activation feasibility and efficiency of pedicels as a route for obtaining an activated carbon. The chemical agents used are (H₃PO₄+HCl). The modeling of isotherm and the kinetic of amoxicillin adsorption (pollutant) are also discussed. Adsorption kinetic is correctly described by the pseudo-second-order model, with a relatively high regression (R²=0.980). To modeling the adsorption isotherm, four models were tested, Langmuir, Freundlich, Temkin and Redlich-Perterson. Langmuir isotherm gives the most adequate experimental data adjustment (R²=0.967). The results obtained are very interesting, indeed, they show the possibility to convert the precursor into an activated carbon, with what all this implies as socio-economic impacts positive for Algeria and even beyond.

KEYWORDS : Adsorption, Amoxicilline, emerging pollutant, water pollution.

SYNTHESIS AND CHARACTERIZATION OF ACTIVATED CARBON COATED BY ZINC OXIDE NANO-PARTICLES AND ITS PERFORMANCE ON ADSORPTION OF METHYL BLUE

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ABSTRACT

Activated carbon remains the most used adsorbent for water treatment. Nanoparticles showed also promise results in adsorption due to their high surface specificity. In the present work we study the performance of a mixed adsorbent prepared from activated carbon (AC) coated by zinc oxide nanoparticles (ZnO-np). This prepared material was first characterized by XRD and FTIR and then applied to the removal of Methyl Blue from aqueous solution at various parameters (pH, adsorbent mass and contact time). The amount of dye uptake was found to vary with increasing initial solution pH and maximum adsorption was observed at pH 9,2. The amount of dye uptake (mg/g) was found to increase with increase in dye concentration. We remark that the adsorption process is very rapid in the first 15 min, The quantity of the dye adsorbed increases with increase of the mass of adsorbent until attained saturation to 0,3g mass then decreased considerably until the equilibrium achieve. The % adsorption was found to decrease with increase in amount of adsorbent. Kinetics obeys pseudo-second order and the Langmuir model adequately describes the adsorption isotherms. The present study implies that activated carbon (AC) coated by zinc oxide nanoparticles (ZnO-np) is promising in practical removal of MB dyes from aqueous solutions.

MOTS CLÉS : Adsorption, cationic dye, zinc oxide nanoparticles coupled with activated carbon, XRD, FTIR.

ENGINEERING OF SIZE-CONTROLLED MAGNETIC NANOPARTICLES FOR USE AS DRAW SOLUTION IN FORWARD OSMOSIS PROCESS

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ABSTRACT

Forward osmosis (FO), an osmotically driven process, is a promising technique for urine concentration and nutrients recovery. However, urine has an extremely high osmotic pressure (8?11MPa) which increases further during concentration. Therefore, for a successful urine concentration a draw solution with high osmotic pressure is required. While inorganic salts solutions generate high osmotic pressure, their recovery is difficult and energy intensive. An easy to recover draw solution is therefore needed. Recently, few researchers reported that an easy to recover draw solution made of coated magnetic nanoparticles (MNPs) could be engineered. However, synthesis of coated MNPs for use as draw solution is not yet well mastered and not well understood. It is assumed that the size, dispersion, coating ratio and properties of coated MNPs are crucial important factors affecting the performance of the draw solution. In this study, we investigate the effect of several parameters exemplified by synthesis temperature, choice of alkaline solution concentration, introduction of MNPs sonication, and timing of coating material addition (separate or simultaneous co-precipitation and coating) on the size, dispersion coating ratio and properties of coated magnetic nanoparticles. Chemical precipitation was adopted for the synthesis of MNPs. The coated nanoparticles were characterized using SEM, XRD, coating ratio and osmotic pressure and flux generation. Findings show that although the particle size distribution was not changed by heating at 80 °C during the coating process, an increase in the coating ratio was confirmed. Moreover, by separating the co-precipitation process and the coating process, the coating ratio increased and the particle size distribution became uniform with a small particle size. By introducing ultrasonic treatment after washing the magnetite particles, it was confirmed that the coating ratio increased and the particle diameter decreased. In the other side, it was found that lower alkaline solution concentration favors a better coating. Finally, it is important to mention that FO tests revealed that MNPs with good dispersion and smaller particles induced a better flux.

KEYWORDS : Forward osmosis, urine concentration, Draw solution, Magnetic nanoparticles, coating ratio

IMPACT DES EAUX USEES SUR LA QUALITE DES SOLS AGRICOLES PAR EVALUATION DE LEUR CONTAMINATION PAR DEUX METAUX (Cd et Pb) AVEC ETUDE DE LEUR SPECIATION ET LEUR BIODISPONIBILITE

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RESUME

L'eau, ressource naturelle indispensable à la vie, est aussi devenue, de manière directe ou indirecte, la première cause de mortalité et de maladie dans le monde. Les eaux usées qui peuvent être définies comme les eaux dégradées par les activités des hommes ont des impacts sur l'environnement notamment le sol et la santé de l'homme.

En effet, l'irrigation des sols agricoles par ces eaux usées contribue à la pollution du sol. Ainsi on se propose dans ce présent travail d'évaluer d'une part la contamination ou le risque d'une contamination métallique par deux éléments traces métalliques (ETM) (Cd, et Pb) des sols agricoles irrigués par les eaux usées, à proximité des axes urbains, routiers, de mieux comprendre la sensibilité des sols aux dépôts des polluants métalliques, dire si ces sols joueront ils un rôle d'immobilisation des métaux lourds ou transféreront ils ces métaux à la végétation et les animaux (biodisponibilité) donc vers l'homme.

PHYTOPLANKTON CHARACTERIZATION OF A DOMESTIC WASTEWATER

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ABSTRACT

This study is to characterize the phytoplankton population in an ecosystem of wastewater located in El Mahdia. Biodiversity indices (Shannon index and Pielou index) of the various basins of the wastewater treatment station, going from input to final output, have been followed. A very high algal density with a relatively low species diversity was observed during the study period. The results showed that the wastewater discharged into the sea is a rich Cyanophyceae environment. These Cyanophyceae have shown a strong adaptation to physical and chemical conditions of the basins in relation to other classes namely the Chlorophyceae, the Diatoms, the Euglenophyceae, the Dinoflagellates and Chrysophytes.

The study of the phytoplankton structure highlighted the dominance of three major species of Cyanophyceae: the Oscillatoria, the Synechococcus and the Synechocystis, which are known for their toxic potential.

KEYWORDS: Treatment station, Cyanophyceae, indices of biodiversity and similarity.

BOX-BEHNKEN DESIGN FOR THE DESALINATION OF SEAWATER USING MEMBRANE DISTILLATION PROCESS

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ABSTRACT

Direct contact membrane distillation (DCMD) using PVDF membrane was investigated in order to desalt Mediterranean seawater. Modeling and optimization was performed using the statistical tools of Box–Behnken design. Three parameters are used for this study; including temperature difference, feed flow rate and permeate flow rate. DCMD performances are evaluated in term of permeate flux (Jp) and thermal efficiency (TE). The results show that temperature difference was the most influenced parameter on DCMD performances. Statistical modelling shows a great agreement with experimental results, the regression coefficients equals to 98.37% for Jp and 96.49% for TE. The desalination of seawater under optimum operating parameters lead to obtain a high permeate flux of 9.27 L/(m².h) and a good thermal efficiency of 81.57%.

KEYWORDS : Desalination, Membrane distillation; Box-Behnken design; Permeate flux; Thermal efficiency.

EXPERIMENTAL AND NUMERICAL STUDY OF LIQUID LIQUID EXTRACTION OF DIODE AND SALICYLIC ACID FOR WATER TREATMENT

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ABSTRACT

Liquid – liquid extraction or solvent extraction is a separation process which is based on the different distribution of the components to be separated between two liquid phases. It depends on the mass transfer of the component to be extracted from a first liquid phase to a second one.

The objective of this work is to study the liquid-liquid extraction of diode and salicylic acid by solvent, the experimental study made it possible to clarify the influence of certain operating parameter such as: contact time, Initial concentration, agitation rate, volume ratio, and initial pH. The results showed that the solvent which gives the best results for the two extracts is dichloromethane and that the parameters which give the maximum yield for the diode and the salicylic acid respectively are a contact time of 30 and 45 min. Vorg / Vaqu : 0.25 and 0.4, Stirring speed: 300 and 200 (rpm), initial pH: 9.51 and 10.77, Initial concentration of 0.05 mol / l for the two extracts.

Finally, the number of stages necessary for the extraction of dioxide and salicylic acid can be found experimentally and by a numerical method.

KEYWORDS : liquid-liquid extraction, diode, salicylic acid.

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DEVELOPMENT OF DECISION SUPPORT FRAMEWORK FOR ASSESSING THE SUSTAINABILITY OF DIFFERENT SEAWATER DESALINATION TECHNOLOGIES : UNITED ARAB EMIRATES CASE STUDY

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ABSTRACT

Full sustainability appraisal of all desalination options is necessary to determine which technologies perform the best in regards to environment, economic and social aspects. It is widely recognized and accepted that sustainability assessments should take a life cycle approach, taking into account all relevant sustainability aspects. Therefore, an integrated framework for assessing the sustainability of different desalination technologies is presented in this study. This framework integrates the three pillars of sustainability, techno-economic, environmental and social using different tools of the multi-criterial decision analysis (MCDA) such as the multi-attribute value theory (MAVT) and the analytic hierarchy process (AHP). Each pillar of the sustainability is assigned different set of indicators. The techno-economic framework has been assigned 6 indicators allowing the cost and technical assessment to be carried out. Furthermore, the environmental aspect indicators are assessed through SimaPro software using TRACI and Eco-Indicator 99 impact categories. Regarding the social aspect of sustainability, some indicators are accounted quantitatively such as the provision of local employment indicator; others are based on individuals' perceptions and behavior and are measured on a qualitative scale. Both expert's stakeholder and experts from the academia fields are engaged in this study using MCDA survey to determine the relative weights of three main sustainability pillars as well as the indicators assigned to them. The usage of MCDA allows to model their opinion and to compare how differing perspectives may affect the choice of desalination option. The decision hierarchy tree is produced using the Web-HIPRE that allows the assessment of desalination sustainability by aggregating all indicators weights taking into consideration each alternative's performance under each sustainability indicator. This framework is developed primarily to assess the sustainability of the three main desalination methods (MSF, MED, and RO) in UAE, but can be applied to other desalination technologies as well as other countries.

Acknowledgement

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PERFORMANCE OF ION-EXCHANGE MEMBRANES FOR THE TREATMENT OF HARD WATERS BY ELECTRODIALYSIS

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ABSTRACT

The distribution of water on Earth is uneven, moreover, the drinking water are decreasing in recent year. To deal with the shortage, conventional electrodialysis (ED) with ion-exchange membranes (IEMs) is applied for demineralization or purify of waste water to production of high quality water. The purpose of this study is to treat hard water by electrodialysis [1], two types of hard water solutions have undergone electrochemical treatment: synthetic and natural water. Indeed, our membranes used in this process gives good results with calcium test solutions becoming depleted in the synthetic solution and in the real one. The cationic membrane presents a good selectivity for the transfer of calcium and magnesium ions, which are responsible to the hardness of water, from synthetic and real water respectively. The softening water has been obtained for two solutions. We now intend to use big cells with continuous solution flows in the aim to confirm its suitability for large industrial applications.

KEYWORDS : Electrodialysis, Calcium and magnesium, ion exchange membranes, selectivity.

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A NOVEL COMPOSITE MEMBRANE FOR SELECTIVE RECOVERY OF LITHIUM BY ELECTRODIALYSIS

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ABSTRACT

There is an increasing demand on the lithium sources due to the rapid expansion of the lithium battery market [1]. Therefore, the selective recovery of lithium from seawater is gaining much interest from both fundamental and experimental researches [2].

In the present work, we have incorporated a lithium-conductor powder into an ion-exchange polymeric matrix to enhance the mechanical and chemical properties and the selectivity of the so obtained composite membranes. Many experiments were carried out to optimize both the synthesis process and the appropriate composition with various amounts of different compounds. Indeed, the results show that the composition of membranes has a major impact on their morphological, thermal, mechanical, structural and electrochemical properties.

The performance of these composite membranes was tested in electrodialysis of reconstituted solutions containing a mixture of sodium and lithium ions. We observed a remarkable selectivity for Li which we attribute to the combined effect of the lithium-conductor powder and the chloride exclusion by the polymer.

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EFFECT OF THE ELECTRODES CONNECTION MODE AND THE RECIRCULATION OF THE EFFLUENT ON ELIMINATION OF A SYNTHETIC TEXTILE WASTEWATER BY ELECTROCOAGULATION

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ABSTRACT

During recent years studies carried out on textile dyes have shown that they are among the most toxic elements, including the long term effects of their toxicity, since they are carcinogenic and also very harmful for living beings. Indeed, in order to avoid this problem, attempts have been made with using efficient technologies to remove these dyes, or at least reach very low concentrations in industrial effluents. In this work, we studied the in experiments the elimination of the red nylosan dye present in the textile wastewater using electrocoagulation (EC) technique in continuous mode. In the first part, we studied the effect of current density and the connection mode of the electrodes (bi-polar: BP, mono-polar in parallels: MP-P and mono-polar in series: MP-S). In the second part of this work, we were interested to the study of the influence of the recirculation of the effluent on the performances of the EC technique. We could conclude that the EC method is an efficient removal process within our operating conditions, especially with the MP-P mode.

MOTS CLÉS : Electrocoagulation (EC), Aluminum electrodes, Turbidity, Color, textile wastewater, Connection mode, Recirculation.

EVALUATION OF CHEMICALLY TREATED PIN CONES AS POTENTIAL BIOSORBENT FOR TREATMENT OF CATIONIC DYE CONTAMINATED WATERS : EQUILIBRIUM MODELLING

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ABSTRACT

The biosorption of a cationic dye, crystal violet (CV) from aqueous solution on chemically treated pin cones (TPC) was investigated at different temperatures (25, 35 and 45°C). The chemically treated pin cones was characterized by isoelectric potential (pH_{ZPC}), scanning electron microscopy (MEB) and the functional organic groups were determined by the Boehm titration method. The influence of operating conditions such as initial concentration of the dye, ionic strength, initial solution pH and temperature on dye removal was discussed. Equilibrium biosorption data at different temperatures were analyzed using Langmuir, Freundlich, Elovich, Harkins-Jura, Flory-Huggins, Dubinin–Radushkevich and Kiselev isotherm models.

KEYWORDS : Biosorption; crystal violet; treated pin cones; characterization; isotherm; modelling.

STRUCTURE, SPECTROSCOPIC MEASUREMENT, THERMAL STUDIES AND PHOTOCATALYTIC PROPERTIES OF NEW HYBRID COMPOUND OF AQUAPENTACHLOROINDOIDE (III) COMPLEX

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ABSTRACT

A new organic-inorganic complex, bis (4 amine pyridinium) aquapentachloroindoidate (III) (C₅H₇N₂)₂ [InCl₅(H₂O)], was synthesized and characterized by single crystal and powder X-ray diffraction, vibrational spectra, thermal analyses (TGA and DTA) and Carbon-13 Nuclear Magnetic Resonance. The single crystal X-ray diffraction studies revealed that the compound crystallizes in triclinic *P*-1 space group with cell parameters $a = 6.8852(3) \text{ \AA}$, $b = 11.6914(5) \text{ \AA}$, $c = 11.9603(6) \text{ \AA}$, $\alpha = 108.812(4)^\circ$, $\beta = 102.028(4)^\circ$, $\gamma = 92.835(3)^\circ$ and $Z = 2$. Its atomic arrangement can be described as an alternation of organic and inorganic layers along the *a*-axis. The crystal packing was governed by the N–H...Cl and O–H...Cl hydrogen bonding interaction between the 4-amine pyridinium cations and the octahedral [InCl₅(H₂O)] anions and π - π stacking interactions in which they may be effective in the stabilization of the crystal structure. Furthermore, the photocatalytic degradation of methyl orange (MO) was studied under visible light irradiation, indicating excellent photocatalytic activity. Importantly, this approach provides an innovative way of enhancing the photocatalytic effect with potential applications as a catalyst support.

KEYWORDS : Organic- inorganic hybrid, X-ray diffraction, SEM, Thermal studies, photocatalytic.

COPPER DOPED α -Fe₂O₃ NANOPARTICLES SYNTHESIZED THROUGH CO-PRECIPIATION TECHNIQUE FOR PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE

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ABSTRACT

Pure and copper (Cu concentration varying from 2 to 8%) doped hematite (α -Fe₂O₃) nanocrystals were synthesized through co-precipitation method using simple equipment. X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Fourier Transform Infra-Red (FT-IR), Raman spectroscopy, Differential Thermal Analysis (DTA), Thermo Gravimetric Analysis (TGA) techniques were used to characterize the synthesized samples. XRD measurements confirm that all the prepared nanocrystals consist only in nanocrystalline hematite phase. These results along with TEM and SEM show that the size of the nanoparticles decreases with Cu-doping down to 21 nm. FT-IR confirm the phase purity of the nanoparticles synthesized. The Raman spectroscopy was used not only to prove that we synthesized pure and Cu-doped hematite but also to identify their phonon modes. The TGA showed three mass losses, whereas DTA resulted in three endothermic peaks. On the other part, the photocatalytic activity of undoped and Cu-doped α -Fe₂O₃ nanoparticles was studied using methylene blue (MB) as model organic pollutants. The hematite nanoparticles doped at 8% of copper disclosed that the discoloration of MB reached 96 % after irradiation of 120 min.

KEYWORDS : Nanoparticles; Hematite (α -Fe₂O₃); Co-precipitation; Copper-doping; photocatalytic; methylene blue.

ALTERNATIVE OXIDANTS IN SEAWATER INDUSTRIAL COOLING TOWERS FOR BIOFOULING CONTROL

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ABSTRACT

Due to the lack of freshwater and groundwater resources in Saudi Arabia, a significant amount of seawater was used in cooling towers operation. The demand for seawater as an alternative evaporative cooling medium in cooling towers has increased significantly. However, the seawater cooling towers have higher challenges because it is an open system where biofouling and bio-corrosion occurring within the fillers and piping of recirculation systems can substantially mitigate their performances.

In this paper, the effectiveness of common oxidizing, inorganic biocides such as chlorine (which is currently used at most cooling tower operation in Saudi Arabia) to alternative oxidants such as ozone and chlorine dioxide were investigated. Effects of seawater temperature, Cycle of Concentration (COC) and biocide dosage (i.e., oxidant) which are critical in cooling tower operation.

The results show at bench scale that at lower oxidant dosage (TROequivalent = 0.1 mg/l Cl₂), chlorine dioxide seems to have a better disinfection than chlorine and ozone in seawater. However, at higher dosages, ozone and chlorine dioxide biocides have similar disinfection capability. Amongst the pilot scale, the disinfectants of Ozone have greater removal of bacteria and algae, and this is followed by Chlorine dioxide, while the conventional chlorine dosing has a lower reduction in bioactivities.

KEYWORDS : Chemical disinfection ; Biofouling ; Cooling tower

AMMONIACAL NITROGEN REMOVAL FROM WATER BY TREATMENT WITH TUNISIAN NATURAL CLAY

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ABSTRACT

The objective of the present study was to investigate the removal of nitrogen in the form of ammonium ions N-NH_4^+ from aqueous solution using natural clay. The Tunisian smectitic clay from Beni Aych area in north western of Tunisia (Grombalia) was used as natural adsorbent materials. A series of batch experiments were conducted to ascertain the ability of natural clay (smectite clay) to remove ammonium from synthetic wastewater samples composed of ammonium acetate ($\text{CH}_3\text{CO}_2\text{NH}_4$). Esteemed ammonium adsorbed was favored by low sorbet concentration, small particle size of sorbent, and an alkaline medium. The sorption kinetics studies strongly indicated that the sorption process was largely governed by interlayer spaces diffusion and that ten minutes are sufficient to adsorb a maximum of ammonium. The sorption increase with temperature from 20 to 40°C. The equilibrium data fitted the Langmuir sorption model, a possible indication of monolayer coverage of ammonium ions on the surface of the particle. The Langmuir correlation of the equilibrium data suggested that ion exchange might have been the dominant sorption mechanism. The smectite clay seemed to have some fairly good potential for ammonium removal with the sorption capacity being about 0.5 mmol (NH_4^+) per 100mg of sorbent. However, this needs to be investigated further through flow-through conditions and in the presence of other ions as in real wastewater.

KEYWORDS : *Adsorbent; Ammonium Nitrogen; smectitic clay; synthetic wastewater.*

A DRAW SOLUTION RECOVERY PROCESS AND FLUX BEHAVIOR IN FORWARD OSMOSIS DURING DESALINATION

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ABSTRACT

Access to the clean water is one of the most important issues in the world and would be the future challenge too. Forward osmosis desalination has recently gained worldwide attention because it operates at low levels of pressure and temperature and it has the potential to provide a reliable and cost effective technology for producing fresh water with low energy consumption, high performance and less fouling. In this study, we investigate the forward osmosis (FO) process to desalinate water using cellulose triacetate (CTA) membrane and ammonium bicarbonate (NH_4HCO_3) as draw solution. The system consists of three stages: (1) water permeation through the membrane, (2) draw solute and water separation, (3) draw solute recovery. Upon moderate heating at 59°C, the draw solution, diluted by water permeated through the membrane from the feed solution, is decomposed into ammonia and carbon dioxide gases that can be separated and recycled as draw solutes, leaving the fresh product water. Lastly, the draw solutes are then recovered back into the system. Experimental runs showed a maximum permeate flux of 4.68 L/m².h using 2 mol/L draw solution with low energy consumption. In addition, ammonium bicarbonate is presented as a viable draw solute in forward osmosis (FO) desalination.

A FOULING COMPARISON STUDY OF ALGAL, BACTERIAL, AND HUMICORGANIC MATTERS IN SEAWATER DESALINATION PRETREATMENT USING UF CERAMIC MEMBRANES

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ABSTRACT

This paper investigates three types of organic matters, namely algal organic matter (AOM), bacterial organic matter (BOM), and humic organic matter (HOM). These organics are different in properties and chemical composition. Therefore, they were systematically studied to understand whether they behave differently or similarly in reference to organic fouling of ceramic ultrafiltration (UF) membranes. (AOM), (BOM) and (HOM) were compared in terms of fouling behavior, removal efficiency, and divalent impact. UF experiments have been conducted at constant flux mode using (5 kDa) and (50) kDa ceramic membranes. Six filtration cycles were tested in duplicates, with a cycle consisting of thirty minutes operation followed by hydraulic backwashing for one minute. AOM and BOM were extracted from marine algae, *Chaetocerosaffins* (CA) and marine bacteria, *Pseudidiomarina atlantica* (*P. atlantica*) respectively in the lab, while commonly used (Suwannee River) humic acid was used as HOM. These organics have been spiked separately into synthetic seawater feed with a total TOC of (0.5 mg/L). Results showed that more TEP/organics were removed by the 5 kDa membranes compared to the 50 kDa membrane, which is accounted for by lower MWCO. The UF 5 kDa membrane also showed low fouling formation than 50 kDa membrane for all of three types of organic matter tested. Analysis of the fouled membranes by SEM images showed that fouling was dominated by cake layer formation for the 5 kDa membrane while pore blockage followed by cake layer formation is apparent for the 50 kDa membrane. The SEM images also revealed that a cake layer is formed for all types of organics tested; the flux was stable over the filtration periods for AOM and BOM, most probably due to the high porosity of the cake layer. For 50 kDa membranes, AOM and BOM organics presented a similar fouling behavior and mechanism. However, AOM was quite higher compared to BOM concerning of TEP concentrations and gel-like formation; this is probably attributed to high polysaccharides concentration in AOM. For 5 kDa membranes, AOM and BOM showed thinner cake layer during all filtration cycles using 5 kDa membranes as TEP particles derived from AOM and BOM have evolved this process by making the cake layer more compact and compressible which in turns enhances the fouling resistance and reduce the porosity of the cake layer. HOM cake layer was thicker than those for AOM and BOM. This cake layer was found to be more porous and less compact, and this occurred more likely when HOM particles bind with Ca molecules offering large aggregates and leading to the high porosity of the HOM cake layer on the membrane surface. The divalent cations such as calcium revealed a strong influence on membrane fouling. In this experiment, the HOM particles were most likely influenced than AOM and BOM, which bridge/adsorb more organic molecules when interacting with calcium ions making the membrane less negatively charged and enhancing the membrane fouling. However, this fouling was less severe compared to AOM and BOM fouling.

KEYWORDS : SWRO pretreatment ; UF Ceramic membranes ; Fouling, AOM, TEP.

TRAITEMENT DES SOLUTIONS DE CHROME HEXAVALENT PAR COUPLAGE PROCÉDES

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RESUME

Ce travail a pour objectif l'étude de l'élimination du chrome (VI) provenant des rejets industriels par procédés électrocoagulation et nanofiltration. Nous présentons les problèmes posés et les risques associés à l'emploi des dérivés chromiques qui s'expriment essentiellement au niveau cutané, respiratoire et même immunologique, ensuite nous avons exposé les deux procédés électrocoagulation et nanofiltration.

L'élimination du chrome (VI) (alodine) par ces deux procédés a été étudiée en mettant en œuvre une méthode de dosage par spectrophotométrie d'absorption moléculaire après réaction avec le 1,5-diphénylcarbazine (Colorimétrie).

En électrocoagulation plusieurs expériences ont été effectuées en vue de déterminer les conditions optimales pour éliminer le chrome (VI) avec des électrodes d'aluminium.

L'influence des paramètres opératoires de l'électrocoagulation (temps d'électrocoagulation, densité de courant, la salinité et le pH), ainsi que des propriétés physico-chimiques du chrome avant traitement (pH initial, conductivité initial, concentration initial), a été étudiée, dans le but d'atteindre les objectifs annoncés, en réalisant une décantation complète pendant une nuit.

L'efficacité du traitement donne un rendement de 96% pour l'alodine (CrO_3) avec un temps d'électrolyse 45min, densité de courant 1000A/m^2 , 0.5g de NaCl, distance inter-électrodes 2.5cm et un pH=7.

Un rendement de 94% pour la solution de dichromate de potassium ($\text{K}_2\text{Cr}_2\text{O}_7$) avec un temps d'électrolyse 45min, densité de courant 1000A/m^2 , 0.5g de NaCl, distance inter-électrodes 2.5cm et un pH=5 et 88%. Également, nous avons fixé les conditions pour la solution de mélange ($\text{K}_2\text{Cr}_2\text{O}_7 + \text{CrO}_3$) un temps d'électrolyse 45min, densité de courant 1000A/m^2 , 0.7g de NaCl, distance inter-électrodes 2.5cm et un pH=4. Ces niveaux opérationnels optimaux permettent d'avoir une bonne réduction de chrome (VI) pour une concentration de 3mg/l.

Nous avons réalisé aussi une étude sur l'influence de pH pour l'élimination du chrome (VI) par Nanofiltration. Cette étude a été réalisée à pression constante. Les résultats obtenus donnent une meilleure rétention à un pH basique avec une élimination de 50 %, par contre pour un pH acide l'élimination était de 25%, par conséquent on constate que la rétention est plus grande dans le milieu basique.

DECOLORATION DU METHYLE ORANGE PAR ELECTRO-FLOTTATION

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RESUME

L'objectif de ce travail est de déterminer les conditions optimales de Décoloration d'un colorant azoïque (le méthyle orange) en solution aqueuse par électro-flottation (EF). L'EF est une technique de séparation solide/liquide basée sur la suspension des particules par les bulles générées lors de l'électrolyse de l'eau en utilisant des électrodes en acier inoxydables. La méthodologie des surfaces de réponse (MSR) a été utilisée avec succès pour optimiser les paramètres opérationnels affectant le traitement de ce colorant. Les données expérimentales obtenues étaient adaptées à une équation polynomiale de second ordre à l'aide de régressions multiples et ont également été analysés par analyse de variance (ANOVA). Le coefficient de corrélation résultant R^2 a été trouvé égal à 0,997 indiquant que les données réelles s'accordent très bien avec les données prédites, en appliquant le modèle quadratique. Les paramètres optimaux sont un pH = 7.94, une densité de courant de 37.48 mA/cm² et un temps de réaction de 29.98 min. Dans ces conditions optimales, le taux de décoloration est de 96.26%.

MOTS CLÉS : Méthyle orange, Electro-flottation, Décoloration, Optimisation, MSR

MODELLING OF REACTIONS FOR PHOSPHORUS RECOVERY FROM HUMAN URINE BY FIXED BED REACTOR WITH SCALLOP SHELL PARTICLES

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ABSTRACT

Human urine contains phosphorous which should be recovered to produce a solid phosphate fertilizer. We proposed a phosphate recovery technique with crushed scallop shell particles. The kinetic model of the production reaction of calcium phosphate from urine and scallop shell particles in a batch reactor as presented our previous report. To realize a small-scale system for production of phosphate calcium fertilizers a column reactor with gravity flow is more feasible because of less mechanical parts like pump and mixer. In this paper, we performed phosphate fertilizer production with the column filled by scallop shell particles to make a kinetic model of the reactions for phosphorus recovery from human urine by fixed bed reactor with scallop shell particles. As a result, 60% of phosphate in the urine was recovered, then brake through was observed at long term operation. The Ca/P ratio calculated from the amounts of recovered phosphate and released carbonate was almost 1. Long HRT and slow superficial velocity improved recovery rate of the phosphate. A dynamic reaction model for fixed bed reactor was proposed considering transportation of the molecules and surface reaction on the scallop shell particles, and the parameters were determined to give good agreement of the model with the experimental data. The observation of particle surface showed change in the crystal structure resulting in different recovery rate.

KEYWORDS: Scallop shell particles, Calcium phosphate, Diffusion, Partially cover model, Phreeqc

EXERGoeCONOMIC ANALYSIS OF A SOLAR VACUUM MEMBRANE DISTILLATION PLANT

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ABSTRACT

In this paper, an exergoeconomic analysis of a solar-powered vacuum membrane distillation (VMD) plant was performed in order to evaluate the cost of exergy destruction for each component of the plant. The analysis permits identification and evaluation of inefficiencies in the plant and opportunities for improvement in the plant components. The results show that the solar collector has the highest cost rate of exergy destruction because of its low efficiency (the maximum energy yield is 48.12%, while the maximum exergy efficiency is 5.03%), and hence, it will be profitable to reduce exergy losses even by increasing the capital cost. Whereas, it would be advantageous to reduce capital costs in the heat exchanger, the hollow-fiber module and the condenser since they have a very high exergy performance of about 97%, 92% and 80%, respectively. In addition, the cost of exergy destruction for the solar VMD plant could be significantly decreased by improving productivity and increasing the heat recovery in the discharges and condensation.

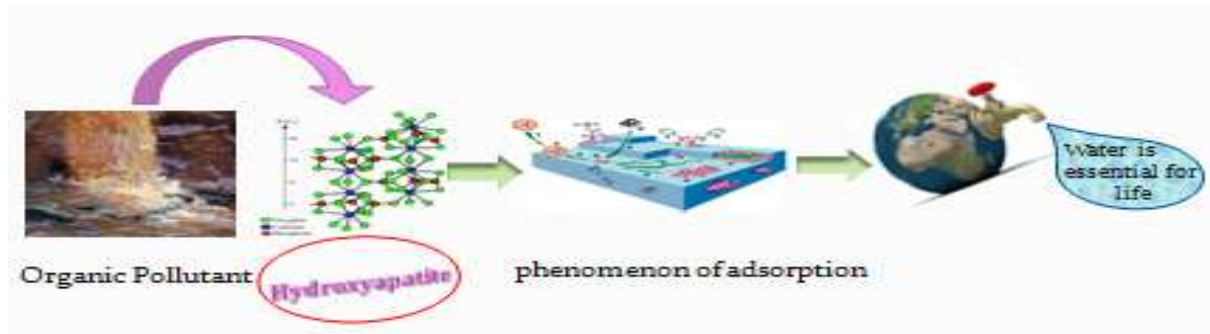
KEYWORDS : Solar energy; Vacuum membrane distillation; Exergoeconomics; Exergy destruction; Cost.

MODIFIED NATURAL HYDROXYAPATITE (DERIVED BLACK PHOSPHATE + POLYMER) TESTED FOR ENVIRONMENTAL APPLICATION

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ABSTRACT



This bioadsorbant was the hydroxyapatite which itself comes from an Algerian mining site. It is followed a grafting chitosan and it is used to eliminate a phenol by adsorption method. The composites obtained by grafting chitosan did not alter the hydroxyapatite crystal structure, the FTIR analyzes reveal new characteristic bands of chitosan. The adsorption tests were carried out in static regime by studying phenol adsorption. The modelling of the adsorption kinetic of phenol into the prepared adsorbents is fitted adequately by the pseudo second-order with an important contribution of the intra-particle diffusion.

Temkin, Freundlich and Langmuir equations are tested for modelling the phenol adsorption isotherms at equilibrium. That Freundlich model fitted the experimental data of phenol onto the prepared adsorbents. The thermodynamic parameters suggested that the adsorption of phenol onto HAp was physisorption, spontaneous and endothermic in nature, $\Delta H^\circ = 3.65$ kJ/mole

KEYWORDS : Hydroxyapatite, chitosane, adsorption, phenol

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ADSORPTION OF METHYLENE BLUE FROM AQUEOUS SOLUTION ONTO WASTE PLASTIC

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ABSTRACT

Adsorption is one of the several techniques that have been successfully used for dyes removal. The adsorption of textile dyes such as methylene blue onto waste plastic was studied for their removal from aqueous solutions. The adsorption of methylene blue occurs by the study of the effects of adsorbent amount, dye concentration, contact time, pH media and temperature. The isotherms of adsorption data were analyzed by various adsorption isotherm models such as Langmuir, Freundlich and Tempkin. All results found concluded that waste plastic could be effectively employed as an effective new low cost adsorbent for the removal of textile dyes from aqueous solutions.

KEYWORDS : adsorption, textile dyes, waste plastic, kinetic

SYNTHESIS AND CHARACTERIZATION OF POLYANILINE /SEAWEED ENTEROMORPHA COMPOSITEBY CHEMICAL OXIDATION METHOD

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ABSTRACT

The Polyaniline/ Enteromorpha composite has been synthesized through oxidative polymerization of aniline with ammouimperoxydisulfate used as an oxidant in aqueous medium. The influence of EP contents (5wt % and 10 wt %) on specific surface area of poly (aniline)/ EP composites was performed. All samples were characterized by FTIR, XRD, SEM techniquesand BET surface area.. FTIR spectra has confirmed the presence of poly (aniline) in the form of conducting emeraldine salt and suggest significant interaction of poly (aniline) with EP.

KEYWORDS : Polyaniline, Enteromorpha, composite.

KINETIC AND THERMODYNAMIC STUDY OF ADSORPTION OF Ni⁺² and Co⁺² IONS IN BINARY SYSTEM ON ZEOLITE A

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ABSTRACT

The adsorption of nickel and cobalt from aqueous solutions in binary system by zeolite A was investigated. The characteristics of zeolite A were determined by XRD, SEM, FTIR techniques. The effects of solution pH, initial nickel and cobalt concentrations C_0 in binary system, solid/liquid ratio R and temperature T were studied in batch experiments. The Freundlich and the Langmuir models have been applied and the adsorption kinetics followed both adsorption isotherms. The follow-up of the kinetics of adsorption of two heavy metals in a binary system according to time showed that the time of balance varies from 2 to 3 hours and that the model of pseudo-second order is adapted the most to describe the kinetic data. Intra particle diffusion model was also used. The thermodynamic parameters namely the enthalpy, entropy and free energy of adsorption of Ni⁺² and Co⁺² ions in binary system on zeolite A were determined.

KEYWORDS : adsorption, nickel, cobalt binary system, zeolite A, kinetic study, thermodynamic study

EMULSION LIQUID MEMBRANE STABILITY IN THE EXTRACTION OF COPPER FROM AQUEOUS SOLUTIONS

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ABSTRACT

Every year a huge volume of waste water is discharged by the mining, metallurgy and smelting industries ; these waste streams may contain significant amounts of heavy metal ions. These metal ions should be recovered for both environmental and economic considerations. In this work, extraction of copper from aqueous solutions by emulsion liquid membrane (ELM) using bis(2-ethylhexyl)phosphoric acid (D2EHPA) as carrier was investigated. An ELM system is made up of hexane as diluent, Span 80 as the surfactant and NaOH as the inner aqueous solution. Influence of operating conditions that affects the stability of membrane such as emulsion time, stirring speed, internal phase concentration, extractant concentration, surfactant concentration, volume ratio of aqueous internal phase to organic phase and the ratio emulsion to aqueous external phase were examined. Under the most favorable conditions, it was possible to remove 95% of copper from aqueous solutions.

KEYWORDS : Emulsion liquid membrane, Copper, stability of emulsion, Emulsion stability.

ÉTUDE DE L'ADSORPTION DU METHYLE ORANGE ET DU CHROME HEXVALENT PAR LE CHARBON ACTIF PREPARE

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RESUME

Notre étude porte sur la préparation d'un charbon actif à partir d'un déchet agricole (la croute du fruit d'arbre nommé - **Brachychitonpopulneus**) pour l'élimination de deux polluants (Le méthyle orange et le chrome hexavalent) en phase aqueuse.

La préparation du charbon actif (CAP) a été réalisée par une activation chimique(NaOH) suivie d'un traitement thermique dans un four tubulaire à 800°C pendant 1h sous atmosphère contrôlée.

La caractérisation physico-chimique a montré que le CAP présente des bandes identiques sur les spectres infrarouge (IR) que celles du charbon actif commercial (CAC). Sa surface spécifique mesurée est de de 804 m²/g.

Les expériences de cinétique, d'équilibre et de thermodynamique ont été menées en réacteur fermé et parfaitement agité. Les résultats obtenus ont été modélisés suivant les équations cinétiques du pseudo-premier ordre, pseudo-second ordre, ainsi que ceux liés à la diffusion externe et intra particulaire. Nous avons constaté que le transport extra granulaire est une étape limitante et que la diffusion interne n'est pas le seul mécanisme contrôlant la cinétique de sorption. Le modèle de Langmuir présente mieux l'adsorption du MO avec une capacité maximale de 55.74 mg/g et celui de Freundlich décrit d'une manière satisfaisante le processus d'adsorption du Cr⁶⁺. L'étude thermodynamique a montré que l'adsorption du Cr (VI) et MO sur le CAP est une adsorption spontanée et de nature physique.

Par conséquent, compte tenu de l'ensemble des résultats fournis par cette étude, le charbon actif préparé à partir du déchet agricole pourrait être considéré comme un adsorbant prometteur et efficace pour l'élimination du MO et du Cr (VI) présents dans les effluents liquides.

MOTS CLÉS : charbon actif, adsorption, méthyle orange, chrome hexavalent.

DIRECT CONTACT MEMBRANE DISTILLATION FOR SYNTHETIC SALINE WASTEWATER TREATMENT: OPTIMIZATION BY RESPONSE SURFACE METHODOLOGY

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ABSTRACT

Freshwater availability is suffering from an increasing pressure created by the growing demand and the environmental pollution that is accompanying the different industrial and agricultural activities that characterize the actual modern life style. Membrane Distillation (MD) comes as a competitive technology for water desalination with considerably lower energy demand in comparison to the conventional desalination processes. In our study, Response Surface Methodology (RSM) is applied to optimize the Direct Contact Membrane Distillation (DCMD) treatment of synthetic saline wastewater in order to enhance the process performance and the permeate flux J_p ($\text{l/m}^2\cdot\text{h}$) by optimizing the operating parameters: temperature difference ΔT ($^{\circ}\text{C}$), feed flow rate Q_f (L/h), salt concentration $[\text{NaCl}]$ (g/L), and glucose concentration $[\text{Gluc}]$ (g/L). DCMD process has led to a high permeate quality with 99.9% electrical conductivity reduction. The predicted optimum permeate flux J_p is $34.14 \text{ l/m}^2\cdot\text{h}$ that was reached at $\Delta T = 55.23^{\circ}\text{C}$ and with a flow rate $Q_f = 37.14 \text{ l/h}$ as the two most influencing parameters. The created model has shown a high degree of correlation between the experimental and the predicted responses with high statistical significance.

KEYWORDS : Direct Contact Membrane Distillation, Response Surface Methodology, desalination, temperature difference, feed flow rate.

RECOVERY OF NEODYMIUM AND SAMARIUM FROM AQUEOUS SOLUTIONS BY POLYELECTROLYTE ENHANCED-ULTRAFILTRATION

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ABSTRACT

Rare earth elements (REEs) are considered strategically important for the development of key technologies such as wind turbines, electrical car engines and medical diagnostics. Therefore, significant quantities of rare earth elements go through the environment and the great problem is the highly efficient recovery of these elements from aqueous solutions. Subsequently, much attention has recently been focused on the use of polyelectrolytes enhanced-ultrafiltration (PAUF) process for recovery of REEs.

Recently, the PAUF process has been shown to be a promising method for recovering RREs from aqueous solutions.

The present work deals with the recovery of two REEs ions (Nd and Sm) from aqueous solutions using poly(sodium 4-styrenesulfonate) (PSS) as a chelating agent. Transmembrane pressure, PSS concentration, metal concentration, pH and ionic strength are the several parameters were optimized for evaluating the recovery process. The results showed that the highest retention of Nd(III) and Sm(III) was obtained at $2 \cdot 10^{-4}$ mol L⁻¹ PSS concentration and 3 bars transmembrane pressure. The pH effect on the neodymium and samarium recovery revealed a maximum retention around 94 % and 99 %, respectively for pH 6. The study of selectivity demonstrated that when both RREs ions are present in the same solution, retention values of neodymium are higher than those of samarium for different PSS concentrations.

KEYWORDS : Neodymium; samarium ; poly(sodium 4 styrenesulfonate) ; recovery efficiency; selectivity.

SYNTHESE ET CARACTERISATION DE NANOCOMPOSITES STYRENE BUTADIENE RUBBER/ARGILES

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RESUME :

Les élastomères sont renforcés par l'incorporation de charges telles que les noirs de carbone ou encore la silice. Ce qui leur confère de meilleures propriétés mécaniques (résistance à la rupture, abrasion, rigidité ...). Actuellement, Le noir de carbone et la silice sont largement utilisés comme matières de renforcement dans l'industrie du caoutchouc [1]. Cependant, La silice, un agent de renforcement «blanc», n'est pas tout à fait réactive au caoutchouc comme le noir de carbone et a donc besoin d'agents de couplage silane pour une meilleure interaction avec les chaînes en caoutchouc. De plus, le temps de durcissement du caoutchouc avec de la silice est plus long que celui du noir de carbone et ceci a pour résultat une productivité réduite. Cependant, l'utilisation d'organo-argiles modifiées dans des nanocomposites polymères-argile a été inauguré par le Groupe de Recherche Toyota du Japon, dans le domaine du renforcement polymère, il a été démontré qu'une forte d'augmentation de la résistance du composite est possible sans diminution de la résistance au choc, ce qui est généralement observé avec des polymères remplis de silice, de carbonate de calcium et d'autres charges inorganiques dans la gamme des microns [2-4]. Plusieurs publications dans le domaine des nanocomposites polymères-argile mettent en évidence les travaux de recherche effectués jusqu'à présent à l'aide de matrices plastiques et élastomères [5-10]. L'objectif de ce travail est l'incorporation de la bentonite, ainsi de l'hydroxyde double lamellaire (HDL), après la préparation des membranes à base du SBR réticulées avec le soufre, afin d'améliorer l'interaction interfaciale et le renforcement entre l'argile nano-dispersée et le SBR. Le but étant de mettre au point des membranes performantes pour le fractionnement de mélanges organiques par pervaporation. Nous avons aussi procédé à la caractérisation de ces membranes par spectroscopie infrarouge à transformée de Fourier (FTIR) et par examen de la diffraction des rayons X et la microscopie électronique à balayage (MEB). Par ailleurs des tests de gonflement ont été effectués pour estimer la densité de réticulation et pour apprécier les qualités de ces membranes en terme de sorption en pervaporation.

MOTS CLES : Membrane élastomère, Nanocomposite, Système de vulcanisation, Réticulation, Styrène butadiène rubber (SBR), Bentonite, Hydroxyde double lamellaire (HDL).

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ENVIRONMENTAL APPRAISAL FOR PROPOSED REVERSE OSMOSIS DESALINATION PLANT IN RED SEA SUDAN PORT SUDAN

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ABSTRACT

Port Sudan is a coastal city located in the north eastern Sudan, on the west coast of the Red Sea. It is one of the big cities in Sudan and the region of the Red Sea, also is the eastern gate of the Sudan.

Port Sudan has been suffering since the end of the seventies of the last century of the scarcity of drinking water.

Most of Red Sea coastal towns have desalination plants to meet their fresh water requirements through the desalination of seawater and/or brackish groundwater (beach wells).

The Reverse Osmosis (RO) technology is selected because it is the most suitable as it is relatively less costly compared with the other technologies.

The environmental impact is one of the important issues of desalination plants. The main methods used for brine water disposals are to return the brine to the sea, to inject it into deep wells, or to pump it to evaporating ponds. Each method has its advantages and disadvantages.

Environmental appraisal or an environmental impact assessment study (EIAS) must be carried out for any desalination plant. This study covers environmental parameters and criteria to evaluate their impact on the air, land, and marine environments and propose measures to mitigate the impact.

This study followed the EIAS guide line and Sudanese environmental law.

The result of the study it can be concluded in :

1. The desalination is an urgent need in the region
2. RO is the best technology for the Port Sudan city.
3. Concentrated brine water from discharge poses a risk to local fish stocks, corals and tourist resorts.
4. Desalination plants require a significant amount of energy for their operation. Secondary impacts resulting from the increase in power production needed for the desalination plants should also be considered. These impacts include higher levels of air emissions, increased entrainment and impingement of fish from intake.
5. The best brine disposal method depends on plant site location

CuO, ZnO and TiO₂ IMPREGNATED NaY AS NOVEL CATALYSTS FOR ADSORPTION AND PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE UNDER SUNLIGHT

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ABSTRACT

NaY zeolite was impregnated by oxides (CuO, ZnO and TiO₂) to prepare novel catalysts for the adsorption and the photo catalytic degradation of methylene blue (MB). The X-ray diffraction shows narrow peaks and the samples are well crystallized. The adsorption of MB on NaY catalyst reaches 94% 60% under optimized parameters ([MB] = 10 ppm, pH = 3, solid/liquid ratio = 3, contact time=30 min and T = 60°C). At highly dye concentration (100 ppm), TiO₂ exhibited superior photo catalytic behaviour compared to NaY, CuO and ZnO catalysts. It seems that TiO₂ conduction band V_{SCE} (-1.58 V) is located below the potential of O₂/O₂^{*}, leading to MB oxidation under solar light within ~ 6 h.

KEYWORDS : Adsorption, Photocatalysis, Methylene blue, NaY zeolite, CuO, ZnO, TiO₂

ADSORPTION OF Ni²⁺ IONS ON SYNTHETIC AND COMMERCIAL NaX ZEOLITES : EQUILIBRIUM, KINETIC, INTRA CRYSTALLINE DIFFUSION AND THERMODYNAMIC STUDIES

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ABSTRACT

Our study aims to adsorption of Ni²⁺ ions onto synthetic (SZ) and commercial (CZ) NaX zeolites. Physical parameters such as pH of solution, solid/liquid ratio, initial concentration of Ni²⁺ ions and temperature were optimized. The best interpretation of the experimental data was obtained by the Langmuir isotherm with a maximum adsorption capacity of 111.85 and 77.57 mg/g for SZ and CZ zeolites respectively. The results show that the kinetic data for both zeolites follow the pseudo second order model, indicating the presence of physical adsorption. The free energy (ΔG°), enthalpy (ΔH°) and entropy (ΔS°) were evaluated and confirms that the feasibility of the process is spontaneous and endothermic. The SZ and CZ zeolites have been applied to wastewater from the Algerian industrial zone in order to eliminate the Ni²⁺ effluents using the optimal parameters.

KEYWORDS : Adsorption, Nickel Zeolite, isotherm adsorption, kinetic, diffusion, wastewater.

PHOTO-REDUCTION DES IONS Cr(VI) SUR DES CATALYSEURS A BASE D'ILLITE-MONTMORILLONITE / HEMATITE Fe₂O₃

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ABSTRACT

Natural Illite-Montmorillonite (IM) clay from Algeria was used in order to prepare heterogeneous catalyst containing semiconductor (Hematite Fe₂O₃) for the photo-reduction Cr(VI) ions. The preparation was made by clay impregnation with Fe₂O₃ by known nitrate method. The IM clay and heterogeneous catalysts were characterized by various techniques: X-Ray diffraction, Scanning Electronic and Energy dispersive spectroscopy. The BET analysis gives specific surfaces of about 92 and 150 m².g⁻¹ for IM clay and IM/Fe₂O₃ respectively. The photo-reduction of Cr(VI) ions on Hematite Fe₂O₃ catalyst was study. The physical parameters as initial concentration of Cr(VI) ions, temperature, catalyst dose an pH solution were also studied. A photo-reduction rate of 82% was obtained in our experiments using IM clay/Fe₂O₃ and in optimum conditions: initial Cr(VI) ions concentration: 50mg.L⁻¹; temperature: 25°C; catalyst dose: 1 mg.mL⁻¹ and pH solution: 2. The results of the kinetic study show that equilibrium is achieved after 3 h and it obeys to a first kinetic order rationalized by Langmuir-Hinshelwood Model with an apparent constant of 0.006 min⁻¹.

KEYWORDS : *Illite-Montmorillonite; clay; hematite Fe₂O₃; chrome (VI); adsorption; photo reduction*

REMOVAL OF NICKEL AND COPPER FROM AQUEOUS SOLUTIONS BY POLY(SODIUM 4-STYRENESULFONATE) ASSISTED ULTRAFILTRATION

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ABSTRACT

Water treatment is one of the main important fields of studies, due to the increase of the world population and industrial activities. Efforts are devoted to optimise the techniques for the prevention and control of pollutions through purification and recycling of wastewaters. Many industrial wastewater streams contain toxic metal cations, therefore, removal, separation and enrichment in aqueous solutions play an important role for the environmental remediation of wastewater.

Polyelectrolyte enhanced ultrafiltration proved to be effective and efficient method for processing waste solutions containing Nickel and Copper ions. In fact the application of polyelectrolyte enhanced ultrafiltration using poly(sodium 4-styrenesulfonate) as complexing agent permitted to reach retention rate higher than 88% and 94% respectively for Nickel and Copper. Several parameters have been optimized such as transmembrane pressure, poly(sodium 4-styrenesulfonate) concentration, pH and ionic strength to improve the retention of the metal ions. The experimental results showed a considerable influence of the pH solution on the metal ions retention, a maximum retention was obtained at pH 5. The study of ionic strength effect demonstrates that it decreases the retention of metal ions and increases the permeate flux. The complexing ability of PSS towards Copper ions is higher than towards Nickel. When both metals are present in the same solution, retention rate decreases compared to single metal solutions, which is more significant in the case of Nickel ions.

KEYWORDS : Nickel, Copper, metal recovery, polyelectrolyte enhanced ultrafiltration, mixture solution.

INHIBITION OF PRECIPITATION OF CaCO_3 ON POLYETHYLENE WALL BY DEGAZING CO_2 IN WATER

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ABSTRACT

Hard water favour the formation of scale deposits in drains pipes water and cooling towers. Indeed, the scaling phenomenon can cause severe technical problems such as reduction of heat transfer efficiency in cooling systems and obstruction of pipes with a great economical impact. The non-productive expenses related to scaling were estimated at 1.5 billion Euros per year in France, about 0.8 billion \$US in Great Britain, 3 billion \$US in Japan and 9 billion \$US in the USA.

Scale is mainly constituted of calcium carbonate. Scale deposition kinetics is generally long under natural conditions. Therefore, different techniques have been proposed to accelerate the phenomenon in the laboratory. In this study, CaCO_3 precipitation is provoked by degassing dissolved CO_2 in a cylindrical cell. To initiate the precipitation of CaCO_3 , the calcocarbonic equilibrium ($\text{CaCO}_3\text{-CO}_2\text{-H}_2\text{O}$) was displaced by outgassing the dissolved CO_2 by bubbling with a continuous flow of gas poor in CO_2 ($8 \text{ L}\cdot\text{min}^{-1}$) according to: $\text{Ca}^{2+} + 2\text{HCO}_3^- \rightleftharpoons \text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O}$

The CaCO_3 precipitation is studied on polyethylene(PE) wall which is widely used in drink water pipes in Algeria. The experimental solution used is calcocarbonically pure water (CCP water) at 30°C . The kinetic study on both substrates has shown that germination time decreases with the water hardness (30, 50 and 70°f) ($1^\circ\text{f} = 10 \text{ mg L}^{-1}$ of dissolved CaCO_3). Moreover, the precipitation rate increases with the water hardness. As expected, the great hardness of water accelerates the scale precipitation.

The inhibiting effect of CaCO_3 precipitation on the PE substrates using MEDHYBIT NO as scale inhibitor which contains organophosphorus compounds and organic polymers were highlighted. The optimum concentration was determined by adding an increasing amount of inhibitor in the solution. It has been shown that the inhibitor acts by threshold effect. In CCP water at 70°f and at 30°C , the optimal concentration to inhibit CaCO_3 precipitation on PE substrate was determinate.

KEYWORDS : scale, CaCO_3 , PE, MEDHYBIT NE, inhibitor

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ASSISTANCE OF ULTRASOUND TO THE BIOSORPTION OF CRYSTAL VIOLET FROM AQUEOUS MEDIA BY UNTREATED PIN CONES

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ABSTRACT

In this study, the pin cones were evaluate as biosorbent for the removal of crystal violet (CV) from aqueous solutions in the absence and presence of ultrasound at 40 kHz. The influence of acoustic power, initial concentration of the dye, biosorbent dose, stirring speed and temperature has been verified in order to explain the influence of ultrasonic irradiation on biosorption kinetics. The acoustic power was an important factor for the enhancement of the removal of CV dye. Equilibrium isotherms were determined by associating stirring and sonication. These equilibrium biosorption data were analysed with five different forms of Langmuir, Flory – Huggins and Freundlich isotherms models. This study showed that the combination ultrasound – biosorption can be an alternative technique to conventional method.

Additionally, the pin cones were characterized by isoelectric potential (pH_{ZPC}) and the acidic and basic sites were calculated by the Boehm titration method.

KEYWORDS : Ultrasound; Biosorption; Crystal violet; Pin cones; modelling.

ADSORPTION DU CRISTAL VIOLET SUR LE CAROUBIER SAUVAGE

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RESUME

Le rejet brutal et massif de résidus toxiques dans le milieu naturel a conduit à l'apparition de nombreux risques pour l'équilibre du milieu naturel et des écosystèmes, ainsi que pour l'homme qui est lui-même producteur de ces déchets et instigateur de ce grand déséquilibre. Ceci a donc encouragé l'amélioration des techniques de dépollution existantes et le développement de nouveaux procédés, permettant de satisfaire et de se conformer aux normes internationales qui sont de plus en plus restrictives. L'objectif principal de ce travail, est de s'inscrire dans une démarche relative à la recherche des supports naturels applicables au traitement des eaux, Pour cela nous avons étudié l'adsorption du cristal violet (CV) sur le Caroubier Sauvage brut. Une caractérisation de la structure chimique et texturale du matériau sera réalisée par la spectroscopie infrarouge à transformée de Fourier (FTIR), la microscopie électronique à balayage (MEB) et le point isoélectrique (pHpzc). Puis des essais d'adsorption du colorant seront effectués en faisant varier les paramètres tels que le pH, le temps de contact, la concentration initiale et la température. En fin une modélisation de l'adsorption sera réalisée pour illustrer les résultats obtenus.

MOTS CLES : Caroubier Sauvage, Cristal violet, procédé d'adsorption, traitement des eaux, supports naturels.

ADSORPTION D'UN COLORANT ACIDE PAR DES ARGILES ALGERIENNES

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RESUME

La protection de l'environnement est devenue un enjeu majeur. Tous les pays du monde sont concernés par la sauvegarde des ressources en eau douce, soit parce qu'ils manquent d'eau, soit parce qu'ils la polluent. Il est donc indispensable de protéger l'eau et limiter les rejets polluants dans le milieu naturel.

Parmi les polluants potentiels, les colorants industriels occupent une position avancée. Ces colorants sont des composés organiques utilisés dans de nombreuses industries : papeteries, cosmétiques, agroalimentaires, textiles, agriculture, produits pharmaceutiques, ainsi que dans des diagnostics médicaux en particulier l'éosine Y.

L'utilisation de l'adsorption sur des argiles d'origine algérienne, sera l'objectif principal pour éliminer les colorants rejetée dans l'eau ; parmi ces argiles nous citons une argile très abondante : la bentonite. Différents paramètres expérimentaux ont été analysés : Température, concentration d'adsorbat et l'isotherme d'adsorption. Les résultats expérimentaux ont montré que l'adsorption des de colorants sur la bentonite dépend de la concentration initiale en colorant, concentration d'adsorbant.

L'application des modèles mathématiques capable de simuler la capacité d'adsorption à montré que le modèle de l'isotherme de Langmuir donne de bons résultats que celui de l'isotherme de Freundlich. Le modèle de réaction de surface du pseudo-second ordre s'applique bien pour le système adsorbant/adsorbât étudié, et les essais cinétiques ont été faits sur une concentration d'éosine Y à 150 mg/L pour garantir que l'équilibre a été atteint après 40 minute, avec une concentration optimale de bentonite de 0,5 g/L.

MOTS CLÉS : Argile Algérienne ; Bentonite ; Adsorption; Adsorbant; Adsorbat ; Colorant acide; Eosine Y; traitement des eaux.

REMOVAL OF PHARMACEUTICAL COMPOUND IN WATER ENVIRONMENT ONTO CALCINED ZnAl-CO₃ LAYERED DOUBLE HYDROXIDES

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ABSTRACT

Recently the contamination of water environment involving rivers, lakes, the sources of drinking water, etc. by pharmaceutical compounds has been paid attention to as a new threat. The behavior of pharmaceuticals found in water environment is not well understood so far. However, they are molecules designed to act on living organisms and their presence in water is unsuitable.

In this study, ZnAl-CO₃ layered double hydroxides at molar ratio $r=3$, were synthesized by coprecipitation, calcined at 500°C and characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), surface measurement by Brunauer, Emmett and Teller method (BET), and determination of point zero charge pH (pH_{PZC}). The adsorption equilibrium relations of diclofenac (an anti-inflammatory) in water environment were investigated. The adsorption isotherm of diclofenac on model surfaces were fitted as the non linear expression by Langmuir, Toth, Sips and Freundlich equations. An important percentage of diclofenac removal is obtained (100%-84.4%) in the concentration range of 5-100 mg/L at 22°C for 20 minutes of contact with solid samples. The Langmuir maximum adsorption capacity of calcined ZnAl-CO₃ hydrotalcite was 457.35 mg/g.

KEYWORDS : water environment, removal, pharmaceutical compound, solid surface.

ELECTROCHEMICAL SENSORS PERFORMANCE : THE ROLE OF SPECIFIC SURFACE AND RECOGNITION RECEPTORS DYNAMIC

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ABSTRACT

Toxic substances such as heavy metals are dangerous for human health and environment at a certain concentration threshold depending on their poisoning mechanism. Toxicity is a function of their degree of solubility and biodegradability. Insoluble substances as well as the metallic forms, exhibit negligible toxicity in most cases. For non-biodegradable substances, their accumulation in living organisms over a lifetime contact induces the increase of their concentration which may exceeds the tolerated threshold limit. Human contamination by heavy metal even at a trace level induces a dysfunction and serious damages to many body systems [1]. For human safety, there is an urgent need to specify tolerance threshold and to develop performing tools for their detection and control. A comparison of electrochemical sensor performances is achieved using self-organized gold nanoparticle (Au NP) modified HOPG electrode and thin gold film as electrode materials. Both electrode surfaces were functionalized with bisphosphonate receptors (BP) [2]. In addition, performances comparison between modified electrode with and without BP receptors is achieved. The obtained results show a detection limit of 0.5 μM for nanomaterial electrode sensor, whereas for thin film electrode sensor it is about 10 pM. These results were discussed in terms of electrode specific surface and recognition receptors dynamic.

KEYWORDS : Gold nanoparticule, surface modification, Electrochemical sensors, Receptor dynamic

ADSORPTION DE L'ACIDE HUMIQUE SUR CHITOSANE

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RESUME

La demande croissante des adsorbants utilisés dans les procédés de protection de l'environnement a fait que leur prix coute de plus en plus cher ce qui suscite une recherche complémentaire pour la fabrication de nouveaux matériaux adsorbants moins couteux à partir des matériaux adsorbants qui ne sont pas classiques, concrètement à partir des déchets de crustacés.

Dans ce travail, nous avons préparé un matériau naturel le chitosane à partir de la chitine extraite des carapaces de crustacés, et nous avons étudié les possibilités d'élimination de l'acide humique sous forme d'humate de sodium dont les structures chimiques renferment des fonctions susceptibles d'interagir à la surface du solide.

L'adsorption de ce polluant sur le chitosane disponible dans la région a donné des résultats prometteurs, ainsi l'acide humique a été éliminé d'une eau synthétique avec un rendement de 65 %.

MOTS CLES : eaux, pollution, chitosane, adsorption, acide humique.

ÉTUDE D'ADSORPTION DES COLORANTS SUR KAOLIN ET KAOLIN MODIFIÉE

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RESUME

Ce travail est consacré à l'étude de l'adsorption du méthyle orange et bleu méthylène sur le kaolin et le kaolin modifiée.

Nous avons tout d'abord procédé à la préparation du kaolin modifiée, ensuite nous avons réalisé des tests d'adsorption afin d'évaluer la capacité et l'efficacité du kaolin et kaolin modifiée pour l'élimination des colorants dans une solution aqueuse.

Les résultats obtenus nous ont permis d'une part, d'affiner notre compréhension sur le mécanisme d'adsorption dans le kaolin et le kaolin modifiée, et d'autre part de vérifier via l'étude comparative de kaolin et le kaolin modifié, l'influence des paramètres physico-chimiques tels que le temps de contact, la masse de l'adsorbant et les concentrations initiales sur les propriétés d'adsorption.

Mots clés : adsorption, kaolin modifiée, colorants, pollution, eau.

TREATMENT OF BILGE WATER BY AN ELECTROCOAGULATION (EC) /CALCINED EGGSHELLS ADSORPTION COUPLING PROCESS.

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ABSTRACT

Water is an essential element for living beings. Without water nobody can not live. After being used, the greater part of this waste water is returned to the environment.

The water pollution affecting rivers, seas, groundwater and lakes is the result of discharges of waste water without treatment or with inadequate treatment; this causes the degradation of the ecosystem.

Major pollution in open oceans as well as in coastal waters occurs by accidental spills and deliberate discharge of the ballast, wash waters from oil tankers, and bilge waste discharges. Bilge water is a complex mixture of various compounds from mechanical parts of ships such as solvents, surfactants, fuel, lubricating oils and hydraulic oils. Various techniques have been proposed to treat bilge water to meet international standard discharge levels, including ultrafiltration, electrocoagulation, UF/photocatalytic oxidation, biotechnological, and UF/membrane distillation. Among the available physicochemical treatment methods, electrocoagulation (EC) technique, has been found to be effective for the treatment of these effluents. On the other hand, adsorption has been found to be a suitable alternative for wastewater treatment.

Eggshell, being a low-cost and largely available adsorbent, appear to be an alternative to more costly wastewater treatment processes. It has been previously used as the sorbent for removal of Cu(II), Pb(II), Cd(II), Cr(III), Cr(VI). Electrocoagulation involves electrolytic oxidation of an appropriate anode material and in-situ generation of coagulant. When a direct current is applied between two electrodes, metal ions such as Fe₂ and Al₃ that can contribute to coagulant formation are released by anode oxidation. In this study treatability of bilge water was investigated by an electrocoagulation(EC) /Calcined eggshells adsorption coupling process. The kinetics of this coupling process was studied to investigate the effect of various operational parameters such as adsorbent dosage, current density (CD), operational time (RT), pH, temperature, on the treatment efficiency. Rejection of chemical oxygen demand (COD) was in the range 92–96 % for the coupling process.

KEYWORDS : Bilge water, eggshells, kinetics, Electrocoagulation and coupling process

PERFORMANCE EVALUATION OF A HYBRID PHOTOVOLTAIC/THERMAL COLLECTOR USING ALUMINA NANOPARTICLES

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ABSTRACT

For many decades, the hybrid photovoltaic and thermal (PV/T) systems have been widely used for the combination of PV modules and solar thermal systems permitted to generate both electrical and thermal energies and cooling in the same time the PV modules. The objective of the present study is adopting nanoparticles within the working fluid for a hybrid PV/T solar collector which is: water and Alumina nanofluid (Al_2O_3 +water) under meteorological conditions of Constantine in east Algeria. A numerical study in a transient analysis is developed by writing energy balances for different nodes: glazing, PV cell, absorber, fluid and back plate.

KEYWORDS : Alumina nanofluid, Water, Performances, Photovoltaic/Thermal.

MODIFIED GAS PERMEABILITY TEST FORESTIMATING MEMBRANE DISTILLATION WATER VAPOUR FLUX

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ABSTRACT

Membrane Distillation (MD) is one of the potential sustainable desalination processes being developed and tested by many research institutes all over the world. It is a thermal desalination process driven by water vapour pressure difference created by two mediums at two different temperatures. The hydrophobic nature of the micro-porous membrane used in the process prevents the liquid phase from wetting the membrane pores while the vapour phase can pass through. Even though the development of MD process involves conducting large number of research for testing commercially available micro-filtration membranes or for developing new membranes for the process, MD literature still lacks a standard test method that can compare the performance of the newly developed membrane with each other or with the commercially available micro-filtration membranes. The conventional method for testing the performance of MD membrane is to conduct an MD experiment to estimate the amount of water vapour that can be collected per unit time for a certain area of membrane. However, running such experiments can be time-consuming approach. Additionally, the performance of a membrane varies widely with the test conditions applied such as feed and coolant temperatures, salinity level and other quality parameters such as fluid velocity, module design parameters etc. which make comparing the performance of such membranes to each other quite challenging. In this paper, we propose a novel testing method that we are hoping to be a founding stone for the development of a testing standard method for the classification of MD membrane performance. The method is based on the principles of the ideal gas law and it uses air as a testing medium instead of water to estimate membrane water vapour flux. The test is conducted under vacuum conditions to imitate the water vapour pressure conditions at the two sides of the membrane as it is applied in the normal DCMD configuration. The results of the new test method were also compared with other results obtained by Direct Contact Membrane Distillation. The findings showed that the accuracy and simplicity of this developed testing technique could be a potential standard test method for estimating MD membrane flux and as a replacement for the conventional testing procedures.

EFFECT OF SIZE SCALE OF TiO₂ ON PHOTODEGRADATION OF DYE RR180

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ABSTRACT

Photocatalytic degradation of organic pollutants from waste water has received enormous attention due to its efficiency, easy operation and production of non-toxic degradation products. In this study, Commercially available photocatalysts, TiO₂ powders with two size scales (size inferior 20 and 150 nm) have been examined as photocatalysts for the UV-induced degradation of dye RR180 in water solution. Characterizations of nanoparticles were done by using FTIR, XRD, and SEM methods. TiO₂ nanoparticles showed the highest photocatalytic activity. In addition, TiO₂ nanopowders (size < 20 nm) had the higher efficiency in photo degradation of dye RR180 under visible light irradiation for 60 min for up to one hours duration but TiO₂ particles (size 150 nm) had the higher efficiency for up to two hours duration.

KEYWORDS : Photocatalysis, TiO₂ nanoparticles, dye RR180, Degradation efficiency.

APPLICATION OF SPATIAL INTERPOLATION METHOD STUDY THE SPATIO-TEMPORAL VARIABILITY OF RAINFALL IN SEMIARID REGION : CASE STUDY OF SOUSSE, TUNISIA

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ABSTRACT

Rainfall data are an essential input for many simulation models which have a decisive role in the development of rational water policies. Besides, in the semi-arid region, there is a large spatio-temporal variability of rainfall influenced by several local and regional factors. This paper aims to study the characteristics of the space and temporal variability of rainfall in Sousse region using monthly rainfall data recorded at 23 stations. The frequential analyses, the principal component analysis (PCA) and the variography were used. Results show an important spatio-temporal variability caused by the effect of the several factors such as the topography, the depressions and the effect of the sea whose behavior of the rains differs from the South to the North of the region. These observations are introduced into the cartography which is carried out by various methods of interpolation, the deterministic methods and geostatistics in aim to establish the maps of isohyets.

KEYWORDS : Spatio-temporal variability, rainfall data, frequential analyses, PCA, variography,

RECOVERY OF WASTE PAPER FOR THE ELIMINATION OF TEXTILE DYES IN WATER

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ABSTRACT

Our work consists in developing the waste of paper as part of the water treatment, Recycling and the means to follow to upgrade this waste in order to save natural resources such as wood. We carried out adsorption experiments of BR46 textile dye on paper pulp used after recycling and washing with distilled water for homogeneity and removal of the anchor. According to the results obtained, a maximum capacity of 100 mg / g is reached at pH= 6. The study of the effect of temperature as a thermodynamic parameter shows that for an increasing variation from 10 ° C to 60 ° C we have a considerable increase in capacity. We note that for the study of the kinetics of adsorption it is of first order and the equilibrium time is about 2 hours.

KEYWORDS : Adsorption, paper, cellulose, textile dye, recycling, recovery.

ÉTUDE DES CAPACITES ADSORBANTES ET CARACTERISATION PHYSICO-CHIMIQUE D'UN MATERIAU EN VUE DE L'ELIMINATION DES POLLUANTS INDUSTRIELS

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RÉSUMÉ :

This work is a contribution to the limitation of the toxic effect of a pollutant (pesticide) used in agriculture, to protect certain food and fruits against insects. The aim is therefore to find mechanisms to limit the effects of these pollutants. We opted for adsorption and choose two adsorbents : industrial activated carbon and animal bone carbon: this last is prepared in the laboratory.

The results showed that the two carbons have similar characteristics: the maximum yield (or adsorption equilibrium) is similar for both: the equilibrium is obtained after seven days. The equilibrium isotherm equation check of Freundlich gave a value of slope $n=0.907$ for animal coal and $n= 0.937$ for industrial coal.

The elimination method chosen to carry out this work is simple and could be used without great expense to clean up waste or contaminated water. This process involves the uses of solid inert biomaterials.

MOTS CLÉS : Acetampirid, activated carbon, animal bone carbon, pollutant, pesticide

MULTIOBJECTIVE OPTIMIZATION OF WASTEWATER TREATMENT BY ELECTROCHEMICAL PROCESS

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ABSTRACT

The aim of this study is to model and optimize the performance of the new as electrocoagulation process (EC) for treating wastewater and energy consumption in order to extrapolate the industrial scale. By judicious application of an experimental design (DOE), it was possible to assess the individual effects and interactions that have significant influences on both objective functions (maximize efficiency and minimize energy consumption) using electrodes aluminum as a sacrificial anode. From preliminary experiments and a thorough review of the literature, the pH of the medium, the applied potential and the time of treatment with EC were the main parameters considered for modelling and optimization. A 3³ factorial design plant was adopted to model the performance and energy consumption. Under optimal conditions, the yield of the pollution abatement was 93%, combined with minimum energy consumption of 2.60.10⁻³ kWh / mg-COD. The potential or current applied and the time of treatment and their interaction were the most influential parameters in mathematical models obtained. The modelling results were also correlated well with experimental ones. The results provide promising opportunities for developing their own to eliminate sewage pollution inexpensive technology.

KEYWORDS : Electrocoagulation, green process, experimental design, modelling, optimization

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INFUENCEOF OPERATING VARIABLES ON THE REMOVAL COPPER AND ZINC IONS FROM TREATMENT SURFACE EFFLUENTS BY NANOFILTRATION

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ABSTRACT

The surface treatment industry produces large quantities of toxic effluents that contain heavy metals (zinc and copper). This study describes the rejection of copper and Zinc ions using a commercial nanofiltration membrane. The effect of the operating variables (pH, transmembrane pressure and feed solution concentration) on the separation process was investigated. It was observed that the rejection of zinc and copper ions slightly increases with increasing the transmembrane pressure and slightly decreases with increasing the metal concentration in feed at constant pH of aqueous solutions. The maximum rejection of zinc ions in single salt solution was 80 % for a feed solution containing 50 mg Zn/L at pH= 6 but the maximum rejection of copper ions in single salt solution was 92% for a feed solution containing 150 mg Zn/L at pH= 11 . Experimental results demonstrated that the NF process could be successfully used for the concentration of copper and zinc in the surface treatment wastewater with high permeates flux, selectivity and performance stability.

KEYWORDS : nanofiltration, the surface treatment , zinc, copper.

DEGRADATION OF AQUEOUS SOLUTIONS OF DICLOFENAC USING GAMMA RADIOLYSIS

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ABSTRACT

Several pharmaceutical compounds have been detected in natural aqueous systems in many countries, especially non-steroidal anti-inflammatory drugs, such as Diclofenac [1]. In this purpose, the degradation efficiency of this compound under gamma irradiation was evaluated using advanced oxidation process (AOP) as an alternative to conventional water treatment technologies. In fact, irradiation of aqueous solutions by ionizing radiation produces several reactive radicals, essentially hydroxyl radical ($\cdot\text{OH}$), to destroy recalcitrant organic pollutants in water [2]. In this study, an optimization of degradation efficiency of diclofenac was investigated using ionizing radiation with and without oxidant addition (H_2O_2).

The considered solutions of Diclofenac 0.2-1.5 mmol/L, were treated by application of irradiation doses from 1 to 15kGy with 6.1 kGy/h rate. The main parameters influencing irradiation performance are absorbed doses and initial concentrations. Significant modifications attributed to these parameters appeared in the variation of degradation efficiency (according to UV absorbance and HPLC analysis), pH and chemical oxygen demand removal (COD). The concentrations of radio-induced radicals of treated solutions were identified and quantified using an electron paramagnetic resonancespectrophotometer (EPR).

Variation curves of considered parameters versus irradiation doses described the required dose for elimination and mineralization of Diclofenac pollutant by ionization. Pseudo first order reaction kinetics could be used to depict the degradation process. Spectroscopic results (EPR) permitted the detection of radio-induced radicals mainly quinone molecules. Preliminary degradation mechanism was suggested based on analytical study using different techniques, namely EPR, FTIR, GC-MS and HPLC. Results revealed diclofenac destruction until total mineralization, which improve the efficiency of this process in water remediation.

KEYWORDS : AOP, radiolysis, diclofenac, COD, EPR, HPLC, FTIR, GC-MS.

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REMOVAL OF REACTIVE ACID DYE BY TiO₂ AND TiO₂ PILLARED-BENTONITE EFFECT OF VARIOUS PARAMETERS

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ABSTRACT

Many dyes are ubiquitous in the environment, since 15-20% of the world dye production is estimated to be released into the environment. Dyes are not easily biodegradable because of increased complexity of chemical structures and presence of aromatic rings. Recent work has reported the use of TiO₂ in the photocatalytic degradation of textile dye, yet TiO₂ powder used as an aqueous dispersion is very difficult to recover. TiO₂ supported on different minerals or TiO₂ thin films therefore appeared to be a promising way to enlarge application fields and overcome TiO₂ recovery problems, mesoporous materials based on clay minerals have been synthesized

In this investigation pillared bentonite composites were synthesized by dispersion of TiO₂ on the surface of a purified bentonite (Na-bentonite) in order to increase the sorption ability of the purified bentonite. Different materials with various loading in TiO₂ were prepared and characterized by several analytical technique including XRD, BET and SEM analysis. The synthetic procedure allows the formation of a more lamellar-like aggregation for the bentonite-TiO₂ sample relatively to the purified one (bentonite-Na). It was found that the greater pore volume and surface area was reached in the case of the greater percent of TiO₂.

bentonite-TiO₂ samples were calcined at different temperatures (200-800°C) in order to prepare a TiO₂-pillared bentonite samples with having more mechanical stability. All these samples (before and after change) were tested as a support to remove a toxic textile dye from aqueous solution (reactive blue II). Experiments were carried out with an aqueous dye concentration of 10⁻⁴M at different pH, greater percent of dye removed was observed when used TiO₂-bentonite and TiO₂-pillared bentonite than the purified one. According to UV results, the higher amount of the dye removed was found at acidic rather than at basic pH. Adsorption results followed pseudo-first order kinetics according to the Langmuir-Hinshelwood model. In conclusion, together with their good sedimentation ability the composite materials (TiO₂-bent and TiO₂-pillared bentonite) could be considered as a promising alternative for the removal of organic water contaminants.

ORGANOBENTONITES FOR TEXTILE WASTEWATER TREATMENT

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ABSTRACT

Surfactant modified bentonite was prepared using hexadecyltrimethylammonium (HDTMA) bromide at three CEC levels (1, 2 and 3CEC), obtained organobentonite labeled H₁-bent, H₂-bent and H₃-bent were characterized by several methods such as X-ray diffraction (XRD), Infrared spectroscopy (IR), thermal analysis (TGA-DTG), Brunauer-Emmett-Teller (BET) and transmission electron microscopy (TEM), these methods were used to provide new visions into the interlayer structure of organoclays.

XRD patterns showed the changes in the d(001) spacings, which gave details of the arrangement of surfactant in the organoclays, IR spectroscopy showed the existence of HDTMA functional groups on bentonite surface. The BET surface area significantly decreased after the modification due to the coverage of the pores of Na-bent. Acid-base potentiometric titration and mass titration behavior of all samples were investigated. The point of zero charge (PZC) estimated by these both methods was about 6.4 for Na-bent and 6.8, 7.7 and 9.1 for H₁-bent, H₂-bent and H₃-bent respectively. Bentonite surface which has hydrophilic property in nature convert to hydrophobic after organophilisation. Hybrid material develops more positives surface charges and great basal spacing layer; therefore these materials can be very useful to remove anionic pollutants from wastewater.

Accordingly HDTMA-bentonites and Na-bent were then tested as an adsorbents for the removal of organic compounds anionic reactive dye (reactive blue II (RBI)), from aqueous solutions, which is very used in textiles industries yet it is carcinogen and very toxic. The amount of adsorption for HDTMA-bentonites was found to be around 4 times higher than that of Na-bent, 98% of dye was removed by H₃-bent without any further modification when only 24% was removed by Na-bent. The results indicate that HDTMA-bentonite is an effective and a low-cost adsorbent for the removal of anionic dye. It was proved that HDTMA-modified minerals have high anion sorption capacity.

KEYWORDS : Bentonite, organoclay, surfactant , anionic dye, adsorption isotherms, thermol analysis

MODELISATION D'UN SYSTEME DISTILLATION MEMBRANAIRE A CONTACT DIRECTE (DCMD)

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RESUME

L'effet des conditions de fonctionnement telles que la température d'alimentation, la vitesse de circulation et la longueur de la membrane sur le flux du perméat et la chaleur dans la distillation membranaire à contact direct (DCMD) a été étudié par modélisation.

Le modèle utilisé est basé sur les coefficients moyens globaux de transfert de chaleur et de masse, qui décrivent les mécanismes de transfert de chaleur et de masse qui se déroulent à l'intérieur du module DCMD. Dans la présente investigation, l'effet des paramètres de fonctionnement sont mis en évidence pour la DCMD à co-courant. La présente étude détermine également la répartition des températures chaudes et froides sur la longueur du module pour la distillation membranaire à co-courant.

MOTS CLÉS : Modélisation ; Distillation Membranaire à contact direct; co-courant; module Osmonic ; PTFE ; le coefficient de transfert de masse et de chaleur.

CATALYTIC AND PHOTOCATALYTIC EFFICIENCIES OF MIXED PILLARED LOCALLY BENTONITE FOR ACID AZO DYE AND REAL WASTEWATER DEGRADATION

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ABSTRACT

Fenton and photochemically assisted Fenton reaction (photo-Fenton) are important because they may be particularly effective for the degradation of harmful organic compounds in the environment using heterogeneous catalysts. The purpose of the present study was to compare the effectiveness of hydroxy FeAl-intercalated bentonites (FeAl-bent) in Fenton and photo-Fenton processes. In particular, different Fe/Al molar ratios were of interest as a means to vary catalytic activity. Intercalation was achieved via an ion-exchange method and Congo red was the test compound for degradation by hydrogen peroxide (H₂O₂) in the dark and under UV-visible light irradiation ($\lambda = 350$ nm) in the presence of FeAl-bent. Also, the degradation of real wastewater was achieved under UV light irradiations. The FeAl-bent materials obtained were characterized by powder X-ray diffraction, N₂ adsorption/desorption, X-ray fluorescence spectroscopy, MET, and ultraviolet-visible spectroscopy. The degradation performance of FeAl-bent was investigated using different experimental parameters, including the Fe/Al molar ratio of the intercalating solution, the catalyst dosage, the H₂O₂ dosage, and the pH. The results of Fenton reaction showed that the catalytic activity of Fe/Al-bent was enhanced significantly by the extent of hydroxy Al/Fe intercalation. For optimal reaction conditions, 50 % degradation efficiency of Congo red was achieved after 240 min of reaction. However, 100 % degradation was achieved after only 60 min under UV light irradiation. So, this catalyst exhibited the highest degradation ratio both for the mineralization of CR and of real wastewater under UV light. Moreover, the catalyst was stable and could be used repeatedly.

STUDY OF THE CORROSION BEHAVIOR OF ZINC AND Zn–Co ALLOY ELECTRODEPOSITS IN WEAKLY ACID BATH CONTAINING SACCHARINE

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ABSTRACT

Co-deposition of Zn–Co alloy coatings that were electrodeposited from weakly acid bath containing saccharine on vitreous carbon has been studied by cyclic voltammetry, chronopotentiometry, ALSV analyses were used to study The influence of cobalt concentration, scan rates and current density of déposition on chemical composition, and phase structure of the coatings. Corrosion behavior of the coatings was also studied using potentiodynamic polarization tests in 0.5M of NaCl solution. Voltammetric and stripping results on vitreous carbon show that co-deposition of the two metals takes place under these conditions. Electrodeposition leads to the formation of a solid solution of cobalt in zinc, detected by only one oxidation peak that shifts from the zinc to the cobalt position as the applied current density – applied potential is made more negative. The corrosion resistance of the deposits was also highly influenced by the composition of the coatings. Overall, Zn–Co deposit elaborated at $-7A/dm^2$ showed that the highest corrosion resistance among the coatings .

KEYWORDS : Electrodeposition; Zn-Co Alloys; Saccharine; ALSV; chronopotentiometry;

OPTIMIZATION OF CHROMIUM REMOVAL BY ADSORPTION ON LEAVES

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ABSTRACT

Wastewater contamination by chromium becomes an important problem due to its widespread applications in industrial processes such as metallurgy, tanning industries, refractories and foundries. Chromium is harmful for environment and threatens the human health as it is a carcinogen element. The World Health Organization defined an upper limit of 0.05 mg L⁻¹ in drinking water. Different studies were carried out on the efficiency of low cost natural adsorbents for heavy metals removal. In this work, chromium removal was investigated by biosorption on leaves. Fourier transform infrared spectroscopy (FTIR), BET and Boehm method were used to characterize the studied adsorbent. Batch experiments were carried out to study influence of several parameters on the adsorption of Cr (VI), including contact time, agitation speed, solution pH, adsorbent dose, chromium initial concentration and temperature. Obtained results for the characterization of the adsorbent revealed that the pH of zero charge is equal to 4.8 and the specific area is about 3.42 m² g⁻¹. The effect of contact time showed that the equilibrium is reached after 3 hours. It was observed that the removal of Cr (VI) is dependent on the pH. A Maximum chromium adsorption of 99% was achieved at pH 2.5 with adsorbent dose of 0.4 g, initial concentration of 100 mg L⁻¹, contact time of 3 hours and agitation speed of 100 tour min⁻¹.

KEYWORDS : Chromium (VI), Adsorption, Leaves, Optimization

EXPERIMENTAL STUDY AND MODELING OF AIR GAP MEMBRANE DISTILLATION UNIT : APPLICATION IN SEAWATER DESALINATION

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ABSTRACT

The single stage air gap membrane distillation (AGMD) has been successfully realized to desalt simulated and naturel seawater. The effect of different operating parameters including feed temperature, width of air gap, feed salt concentration and feed and permeate flow rates on the performance of AGMD process has been investigated. Two different commercial Polyvinylidene fluoride (PVDF) membranes, with different pore size (0.45 μm and 0.22 μm) were tested and compared for different operating parameters. Experimental results displayed that the larger pore size membrane showed a better mass transfer performance but led to a slight decrease of the water production quality. However, AGMD process can produce water with high salt rejection more than 99% and a maximum permeate flux of 9.06 $\text{kg}\cdot\text{m}^{-2}\cdot\text{h}^{-1}$ was obtained at 77°C. Measured permeate flux and AGMD model prediction are compered and present a good agreement. The average deviation between predicted and experimental flux was around 6.9%.

KEYWORDS : AGMD; Desalination, PVDF membrane; Mass transfer; Seawater

ÉVALUATION DE LA SALINITE DES EAUX D'IRRIGATION D'AGRUMES ET DE L'UNITE DE DESSALEMENT PAR OSMOSE INVERSE

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RESUME

Le secteur agricole constitue le majeur consommateur des eaux en Tunisie (~80%) [1]. Ces eaux sont en générale des eaux de surface tels que les rivières et les barrages ou des eaux souterraines (forages). Le majeur problème rencontré, ces dernières années dans certaines régions de la Tunisie, est la salinité élevée due soit aux caractéristiques de la région et du sous-sol, tel le cas du sud de la Tunisie ou de la surexploitation des ressources d'eaux (cas du Cap-Bon).

Des normes et des critères d'évaluation de la qualité des eaux d'irrigation sont adoptées pour minimiser le risque de toxicité des plantes (bore, Sodium, nitrates et métaux lourds) et de la salinisation des sols [2,3,4,5]. Une étude des faciès chimiques des eaux utilisées en irrigation (diagramme de piper) nous prévoit des risques de salinisation et le type du sous-sol [6]. La sodicité due au risque relié au sodium dans les sources d'eau d'irrigation est évaluée par le critère SAR et les diagrammes Riverside de Wilcox [7,8].

De ce faite, les eaux de forages agricoles de salinités élevées et contenant des éléments nuisibles sont dessalées essentiellement par le procédé d'OI qui représente la technique la plus adoptée pour minimiser le risque de salinisation du sol ainsi que les réseaux de drainage.. Ce travail qui entre dans le cadre de dessalement des eaux consiste à évaluer les performances de l'unité OI de dessalement installée à une ferme d'agrumes situé à Soliman. La salinité et la qualité des différentes eaux de dessalement (eau de forage, Eau osmosée, Eau mélangée d'irrigation et eau de rejet) sont aussi évaluées. Les échantillons d'eaux collectés dans différentes périodes sont analysés au Laboratoire LabTEN selon des méthodes normalisées [9]. Les faciès chimiques sont déterminées à l'aide de diagramme de Piper et le risque de salinisation à l'aide des diagrammes Riverside de Wilcox. Les performances de l'unité de dessalement sont évaluées dans différentes période de l'année, En second lieu le procédé OI de dessalement est optimisé en testant d'autres configurations du système d'osmose inverse.

La gestion des eaux de rejet qui varie de 25 à 35% de la quantité traitée, constitue le principal problème de l'intégration des procédés de dessalement des eaux dans le domaine agricole. Son rejet non contrôlé risque d'aggraver d'avantage le phénomène de la salinisation des et des sols ou de la nappe par le rejet.

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PHRAGMIFILTRE : LES ROSEAUX AU SERVICE DE L'EAU

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RESUME

La problématique de l'assainissement des eaux usées en Algérie est un sujet qui demeure entier, malgré les nombreuses initiatives entreprises jusqu'à ce jour. Les objectifs de ce travail étaient d'une part, d'élucider le principe de la **phytoépuration par phragmifiltres** mettant à profit des processus naturels pour le traitement des eaux usées et de déterminer les paramètres pour une performance épuratoire.

Les filtres plantés de roseaux sont des systèmes épuratoires permettant une reconstitution contrôlée des phénomènes d'auto-épuration naturelle : l'épuration résiduaire consiste à éliminer les éléments solides maintenus en suspension, et à réaliser l'épuration biologique de l'eau en éliminant la pollution organique. De manière naturelle, des micro-organismes sont capables de transformer des molécules organiques ou minérales pour leur propre métabolisme. Les roseaux, de part leur système racinaire, ainsi que le substrat de sable et gravier qui constituent les filtres plantés de roseaux "phragmifiltres" créent un milieu favorable à l'activité biologique et au développement des micro-organismes épurateurs, permettant ainsi une vitesse de réaction compatible avec les fortes charges en pollution arrivant au système, et provenant du réseau d'assainissement (eaux ménagères et eaux vannes).

Les techniques de phragmifiltres peuvent être utilisées en complément des procédés intensifs, elles présentent plusieurs avantages : fiabilités, faible coût et respect de l'environnement. Elles permettent ainsi de revégétaliser les sites pollués en améliorant en plus la qualité visuelle de l'espace aménagé.

MOTS CLÉS : phytoépuration, phragmifiltres, roseaux, eaux usées.

ÉLABORATION DE MEMBRANES COMPOSITES EN VUE D'ÉLIMINER DES MICROPOLLUANTS PAR ULTRAFILTRATION

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RESUME

Il s'agit dans ce travail d'étudier l'élaboration des membranes à base de PEBAX et de PVDF en vue de leur application dans l'élimination des colorants dans les eaux textiles. Les membranes à base de PEBAX ont été élaborées par évaporation du solvant alors que les membranes de PVDF ont été fabriquées via coagulation par immersion. La caractérisation de ces membranes nous a permis de définir leur structure et prouver leur caractère semi-cristallin par le biais de la calorimétrie différentielle à balayage où une enthalpie de fusion des cristallites de PA12 d'environ 246 J/g est obtenue dans le cas du Pebax 2533. La synthèse de membranes composites PVDF-cellulose nous a permis par la suite d'envisager une application d'élimination d'un colorant tel que le bleu de méthylène par ultrafiltration. Le pourcentage de rétention obtenu est de 27% pour une pression transmembranaire de 0,8 bar. Une étude d'angle de contact nous a aussi permis de mettre en évidence la possibilité d'améliorer l'hydrophobie d'une membrane en modifiant le bain de coagulation (éthanol, méthanol et butanol) ce qui permet d'envisager des applications dans le cas des contacteurs à membranes.

MOTS CLÉS: membrane, PVDF, coagulation, cellulose, ultrafiltration.

KEGGIN POLYOXOMETALATES ASSISTED-ULTRAFILTRATION PROCESS FOR RETENTION OF DYE

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ABSTRACT

The complexation–ultrafiltration process has been shown to be a promising technique for removal several pollutants in solution. In the present study this process has been successfully applied for the removal of toluidine blue dye from aqueous solution using polyoxometalates type Keggin as a complexing agent. Filtration experiments were performed with ultrafiltration membrane system, equipped with an organic cellulose membrane with a 3 KDa cut-off. Factors affecting the retention rate of dye such as transmembrane pressure, operating time, Polyoxometalates concentration, ionic strength, cetyltrimethylammonium bromide (CTAB) surfactant and pH were investigated. In absence of polyoxometalates the retention of dye is only 11% at dye concentration of 0.1 mM. The addition of POM increases the retention up to 99% in presence of PW₁₁ and 96 % in presence of PW₁₂. The maximum retention of dye is obtained at POM/ TB ratio of 1.

KEYWORDS: Ultrafiltration, Polyoxometalates, complexation, Dye removal, Permeate flux.

NEW HYBRID PROCESS COMBINING ADSORPTION ON PERLITE AND ELECTRO-FENTON USING A PT ANODE FOR THE TREATMENT OF DILUTE WASTEWATER

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ABSTRACT

A new hybrid process that integrates adsorption on a low-cost adsorbent and electro-Fenton (EF) oxidation was investigated for the treatment of dilute dye solution. In such combined process, adsorption is used as a pre-concentration step before the EF oxidation of the pollutant until its total mineralization. Crystal Violet is used as model of dyes and perlite is used as adsorbent. After optimization of the adsorption and the EF experimental conditions, the efficiency of this combined process has been proved and the adsorbent was used in successive adsorption-EF treatments without operational problems.

KEYWORDS : adsorption, Electro-Fenton, dyes.

A STUDY ON THE DEGRADATION OF AN ANTI TUBERCULOSIS DRUG BY ZnO PHOTOCATALYSIS UPON UV LIGHT IRRADIATION

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RÉSUMÉ

Many pharmaceuticals are neither degradable nor adsorbable on sewage sludge [1]. Therefore, the research has recently focused on the application of non-biological processes for the elimination of pharmaceuticals in waters with emphasis on photo-degradation [2]. Photo-catalysis with UV irradiation is one of the most important processes applied in the pharmaceutical wastewater treatment [3] [4]. In this study we have focused in the photo-catalytic degradation of an antibiotic used to treat tuberculosis, in the presence of ZnO as catalyst. The parameters which were varied during our experiments are the pH, the catalyst mass, and the drug initial concentration. Under optimal conditions, about 100% removal was achieved in 45 min. The photo-degradation process followed pseudo- first order kinetic.

MOTS CLÉS : Pharmaceuticals, Photo-catalysis, ZnO, kinetic, degradation

IMPROVEMENT OF THE POROSITY OF POLYMER MEMBRANES BY THE ADDITION OF LIGNIN NANOPARTICLES

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ABSTRACT

In this work, we are interested in the enhancement of the filtration supports porosity by adding lignin nanoparticles. The characterization of the prepared lignin (pore-forming material), extracted from organic waste, was realized using FTIR and DSC analysis. The obtained results prove on the one hand that the extracted lignin is similar to the commercial lignin. On the other hand, the produced lignin nanoparticles with hydroxymethylation are also comparable to those of the literature. These results make possible the incorporation of these nanoparticles in a polymer matrix based on LDPE in order to improve the porosity. The thickness of these supports is approximately 140µm. The measurement of the contact angle shows that the supports are hydrophobic and the intensification of the hydrophobicity is about 12% due to the presence of the lignin nanoparticles, while the porosity can increase with 52.3%. An optimization of the polymer concentration was done and the optimized value was 11.63%.

KEYWORDS : Porosity; Polymeric Membrane; Lignin; nanoparticles; Contact angle.

EFFECTIVE ELECTRO-FENTON REGENERATION OF TUNISIAN CLAY ADSORBENT

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ABSTRACT

In this work the feasibility of electro-Fenton (EF) process in the regeneration of Tunisian raw bentonite used as methylene blue (MB) adsorbent from aqueous solution was demonstrated. By operating under optimized experimental conditions, near complete adsorbent regeneration was achieved after 300 min of EF treatment. Pseudo-first-order model fitted well to the degradation data. Furthermore, the adsorbent was efficiently used in successive cycles of adsorption-regeneration without operational problems.

KEYWORDS : Adsorption, Dye, Regeneration.

MIXTURE STUDY BETWEEN THE ALPHA-ALUMINA AND THE NATURAL APATITE FOR MAKING A LOW COST CERAMIC SUPPORT

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ABSTRACT

The study of the mixture alumina - Tunisian natural apatite and the development of a new ceramic support are presented in this work. The choice of the apatite is based mostly on its low cost (considering its abundance in the Tunisian ores) and for lowering the firing temperature of the alumina. Three compositions between the alumina and the apatite (80/20, 50/50 and 30/70 wt% apatite/alumina) have been studied in three temperatures 1150, 1250 and 1350°C to choose the raw material for the support elaboration.

The mercury intrusion results show that the porosity increases with increasing the alumina amount and decreases with increasing the temperature. The sample microstructure shows that the consolidation temperature decreases with increasing the apatite amount in each composition. The extrusion test proves that we can make a support with the composition 30/70 wt% apatite/alumina without defect (bending, crack...).

The support sintered at 1350°C has average pore diameters and the porous volume 1.87 µm and 38%, respectively can be used such as for microfiltration application or for ultra filtration application by the deposition of some layer in the inner surface of the tube.

KEYWORDS : Apatite, alpha alumina, ceramic support, Microfiltration.

ENERGETIC STUDY OF A SOLAR-POWERED VACUUM MEMBRANE DISTILLATION COUPLED WITH A LIQUID RING PUMP

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INTRODUCTION

Today, humanity faces great challenges on energy, economy and environment. So, there is a strong need to better design, analyze and evaluate energetically processes, systems and applications. Well-established energy research in desalination has helped in the decrease of water treatment costs. On the other hand, the lack of fresh water is considered as a serious problem that is constantly increasing, due to the population growth and changes in weather conditions.

Desalination using solar energy coupled with membrane technology is considered an attractive alternative to the production of drinking water. Membrane distillation (MD) is a new technology that combines distillation and membrane separation. MD is characterized by a lower operating temperature than the typical distillation and lower operating hydrostatic pressures than the pressure-driving process. Furthermore, the operating temperature of the MD process is in the range of 60-80°C, at which the thermal solar collectors perform well.

In this work, we are interested in VMD technology, which is an evaporative process using a hydrophobic porous membrane, whose function is to separate a liquid phase from a gas one.

In VMD, the choice of condensation and vacuum creation systems is an important issue. The conventional solution is to couple a condenser or a heat pump with a vacuum pump. But, the most modern solution is the vacuum liquid ring pump. This liquid ring pump has a dual functionality: condensation and vacuum creation. In this work, a VMD plant coupled with solar energy using a liquid ring pump was studied.

The operation of hollow fiber module and the liquid ring vacuum pump was simulated by programs developed in the MATLAB codes. These programs are based on mass and heat transfer within the hollow fiber module and the liquid ring vacuum pump. The global model developed allowed us to perform a parametric study that quantifies the influence of different parameters on the energy performance of the system. Among the studied parameters, we include the influence of vacuum pressure applied, the inlet feed flow rate and the auxiliary fluid flow rate on the specific energy consumption. The study demonstrated that the enhancement or reduction of energy losses will be mainly by recovering heat lost in brine discharges and by reducing the flow rate of the auxiliary fluid supplying the liquid ring pump.

AN OPTIMIZED PHOTOVOLTAIC ELECTRODIALYSIS SYSTEM FOR BRACKISH WATER DESALINATION

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ABSTRACT

In Tunisia, as in developing countries, the supply problem in drinking water becomes more and more crucial, because of the population growth and of the rise of the standard of living. The desalination of the sea water and the brackish waters is now the answer of request in drinking water. Among the proceeded disputes, the solar distillation is an interesting solution. The objective of this work is to simulation of electrodialysis unit fed by a photovoltaic array to desalt brackish water in MATLAB / SIMULINK environments. to improve efficiency on the distiller, this system coupled with the maximum power tracking controller.

DEGRADATION OF CAFFEIC ACID BY A NOVEL ELECTRO-FENTON PROCESS USING CHALCOPYRITE AS HETEROGENEOUS SOURCE OF IRON CATALYST

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ABSTRACT

Caffeic acid (CA) is one of the most abundant phenolic components of olive oil mill wastewaters. Here, the degradation of synthetic aqueous solutions of 0.10 M CA was studied by a novel heterogeneous electro-Fenton (EF) process, so-called EF-Chalcopyrite, in which chalcopyrite powder was the source of Fe²⁺ catalyst instead of a soluble iron salt used in classical EF. Experiments were performed with a cell equipped with a platinum anode and a carbon-felt cathode, where CA and its products were destroyed by hydroxyl radicals formed at the anode surface from water oxidation and in the bulk from Fenton's reaction between Fe²⁺ and H₂O₂ generated at the cathode. Effects of initial pH, concentration of chalcopyrite, and current density were determined to test and to validate a kinetic model for the oxidation of CA by the electro-Fenton process. Kinetic results show evidence of pseudo-first-order degradation. Addition of 0.7g/l chalcopyrite provided an easily adjustable pH to 1.5. Increasing the concentration of chalcopyrite from 0.2 to 0.7 g/l increased the hydroxyl radicals and then promotes the degradation efficiency of CA. The degradation of CA was increased with the increase of current intensity from 150 to 300mA.

REUSE OF TREATED WASTEWATER IN AGRICULTURE

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ABSTRACT

The purpose of this communication is to contribute to the reuse of treated wastewater (TWW) from the Ain El-Turc (Cape Falcon) wastewater treatment plant (WWTP) in the field of irrigation. This water is already used by the farmers who are adjacent to the WWTP to irrigate their parcels of land planted with vegetation and fruit trees without taking into account the imperatives of malfunction of the WWTP and the possible alterations in the storage ponds of the TWW.

TWW is an interesting alternative water resource in arboriculture irrigation, but this practice must be carried out in accordance with *World Health Organization* (WHO) and *Food and Agriculture Organization of the United Nations* (FAO) guidelines, as well as the current legislation of our country.

The major characteristics of the effluent samples taken from the storage ponds show a pH variation from 8.3 to 9.1, biochemical oxygen demand BOD₅ from 4 mg/L to approximately 6 mg/L, chemical oxygen demand COD from 33 mg/L to 32.8 mg/L and total dissolved solids TDS from 4.3 mg/L to 09.0 mg/L.

The concentrations of heavy metals in the TWW are very low with the recording of quite exceptional abatements of faecal coliforms in the storage ponds.

KEY WORDS: Reuse, Wastewater, Agriculture, Physico-chemical parameters, Irrigation.

TREATMENT OF INDUSTRIAL TEXTILE EFFLUENTS USING COAGULATION FLOCCULATION AND ADSORPTION

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ABSTRACT

The aim of study is about the characterization and the treatment of a textile wastewater. The effluent was recuperated from the Algerian textile industry. During the different sections of production process different dyes and auxiliaries chemicals were used.

The optimization of coagulation/flocculation parameters is the key of high efficiency of treatment. The dose of flocculent and the settling time were constant all the time of optimization and equal to respectively 400mg/l and 40 min.

A commercial powdered activated carbon (PAC) was used to test the adsorption treatment applied to the textile wastewater. Along the optimization essays the settling time was fixed on 24 hours to permit the separation of the powdered adsorbent from the clarified water.

The coagulation of the textile wastewater using the $Al_2(SO_4)_3$ showed 55% removal of color, 90% removal of turbidity and more than 81% removal of TSS. In the other hand adsorption on commercial PAC of the same effluent was efficient on color, turbidity, TSS, and Ca^{2+} removal with respectively 87%, 98%, 96%, and 100% removal.

KEYWORDS : Textile effluents, coagulation-flocculation, adsorption, optimisation

SIMULATION OF PRETREATMENT INDUSTRIAL PLANT FOR TEXTILE WASTEWATER

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ABSTRACT

The water crisis in arid zones became a real economic and human problem. In areas where there are a lack of water, the treatment and recycling of industrial wastewater is important solution. The textile activity contributes annually to large quantities of polluted water; an example of textile unit is taken which generates 350m³/h of wastewater during the process of production. These rejected effluents despite their passage through pretreatment unit do not meet the requirements of the standard industrial wastewater. The objective of this work is to simulate the efficiency of the pretreatment for effluent polluted with colored products from a textile production unit under the same actual operating conditions. The results show that 73% of the total fraction of organic matter is removed, where the nitrogen dioxide is totally eliminated in the effluent.

KEYWORDS : Textile, wastewater, pretreatment, simulation

SIMULATION AND EXPERIMENTAL STUDY OF AN AGMD MEMBRANE DISTILLATION PILOT FOR THE DESALINATION OF SEAWATER OR BRACKISH WATER WITH ZERO LIQUID DISCHARGED

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ABSTRACT

Our work consists in presenting the results of an invention for a membrane distillation system coupled to an efficient and robust water solar collector which produces potable water with high quality and a small percentage of brackish discharge independent of salinity of the water source. Then to optimize and to characterize experimental of the air gap membrane distillation (AGMD) on a pilot plant. During the tests, brackish water was used, ranging from 4.2 to 12.5 g / l of salt. The results show that the permeate flux increases as the temperature and feed rate increase and the thickness of the air gap decreases (from 5.12 to 1.5 mm). Our AGMD system was modeled using Matlab's programming on heat and mass transfer aspects. The 1D model is based on the transfer equations and correlations of the literature present in the membrane distillation pilot. The maximum permeate flux obtained was 7.4 kg / m² h with a hot fluid temperature of 80 ° C., an air gap of 1.5 mm and hot and cold flow rates of 4.8 l / min. For all measurements, the maximum relative difference between the experimental results and the simulated results is observed at 10% errors. The results of low temperature hot fluids can be interesting in the solar energy coupling project.

KEYWORDS : Desalination, Membrane distillation, AGMD, solar energy, coupling.

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DISTRIBUTION OF DDTs BETWEEN DIFFERENT MATRICES: WATER, SUSPENDED PARTICULATE MATTER AND SEDIMENT COLLECTED FROM BIZERTE LAGOON, TUNISIA

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ABSTRACT

In recent years there has been growing environmental concern, especially regarding the use and discharge of toxic substances. Many organic pollutants are detected in the aquatic ecosystems such as pesticides. Because of their large-scale production and usage, toxicity, bioaccumulation and persistence in the environment, they cause harmful effects to organisms and human health. The objective of this work is to investigate the distribution of dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphényldichloroéthylène (DDE) and dichlorodiphényldichloroéthane (DDD) between water samples, suspended particulate matter (SPM) and sediment collected from the Bizerte Lagoon. Water samples were analyzed using liquid-liquid extraction (LLE) with hexane. Extraction method using Soxhlet was used to analyze surface sediment and SPM samples. Analyses were performed by using gas chromatography combined with Ni⁶³ electron capture detector. The DDTs were investigated in water, SPM and sediment from fourteen sampling sites in the Bizerte Lagoon. The average concentrations of Σ DDTs in surface water samples are ND and 8.51 ng L⁻¹. The levels of Σ DDTs in SPM varied between ND and 29.12 ng g⁻¹. The concentrations of Σ DDTs in sediments are in the range of ND-126.49 ng g⁻¹. The concentrations of Σ DDTs in different matrices are generally similar to the background levels from the Mediterranean Sea and pose no threat to human and aquatic living species.

KEYWORDS : Σ DDTs Water, Suspended particulate matter, Sediments, GC-ECD

COAGULATION-FLOCCULATION TREATMENT OF A PULP AND PAPER MILL EFFLUENT

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ABSTRACT

Pulp and paper mills (“mills”) generate millions of tons of wastewater that is discharged into receiving bodies of water, resulting in a major water pollution source. This research completed a characterization of mill wastewater that showed high Chemical Oxygen Demand (COD) and high Turbidity (Tb). The biodegradability index determined by the biochemical oxygen demand (BOD)/chemical oxygen demand (COD) ratio was only 0.072, suggesting its limited biodegradability. The coagulation-flocculation process using chemical coagulants/flocculants prior treatment to equilibrate this ratio in range 1-2 promises a feasible biological treatment. Ferric sulfate, aluminum sulfate ($Al_2(SO_4)_3$ alum) and ferric chloride were used as coagulants whereas anionic polyacrylamide (Paraestol) was used as a flocculent. Alum proved more effective in reducing both turbidity and COD of the wastewater. A series of jar tests were conducted considering different pH values followed by increasing amounts of coagulant and flocculent . The best experimental conditions for coagulation were as follow: pH in the range 3-4, with 150 mg/L alum $Al_2(SO_4)_3$ and 15 mg/L polyacrylamide.

KEYWORDS : anionic polyacrylamide, coagulation–flocculation, COD, turbidity reduction, pulp and paper wastewater.

RESPONSE SURFACE METHODOLOGY FOR BORON REMOVAL BY DONNAN DIALYSIS : DOEHLERT EXPERIMENTAL DESIGN

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ABSTRACT

The removal of boron from solution with Neosepta AFN anion exchange membrane has been studied by Donnan dialysis. The effects of concentration, pH, and accompanying anion on feed phase and receiving phase composition were investigated. A full factor design was performed to determine the parameters affecting the boron removal efficiency and to optimize the effect of the main parameters and their mutual interaction for the DD process. Using the experimental results, a linear mathematical model representing the influence of the different parameters as well as their interactions was obtained. The effect various experimental parameters and optimal experimental conditions were ascertained by response surface methodology using Doehlert. This methodology of surface response estimate the coefficients of a polynomial mathematical model, whose essential interest is to be able to predict in any point of the experimental region, the values of the response. Analysis of the variance (ANOVA), the F-test and the student's test shows that the pH of the solution is the most significant parameter affecting the boron removal.

KEYWORDS : Boron, Donnan Dialysis, Optimization, Response Surface Methodology, Doehlert.

ADSORPTION OF BEZATHREN DYES ONTO SODIC BENTONITE FROM AQUEOUS SOLUTIONS

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ABSTRACT

The aim of the present work was to investigate the adsorption of synthetic textile dyes, such as Bezathren-Blue, Bezathren-Green and Bezathren-Red onto sodium bentonite (Bt-Na⁺). Adsorption experiments were performed under batch process, to assess the performance of Bt-Na⁺ for the removal of Bezathren-dyes, using initial dyes concentrations, pH of solution, contact time and temperature as variables. According to results, the uptake of Bezathren-dyes by Bt-Na⁺ was rapid and the maximum sorption was observed at lowest pH. The maximum uptake capacities (q_m) for Bezathren-Blue, Bezathren-Green and Bezathren-Red were 35.08mg.g⁻¹, 32.88 and 48.52 mg.g⁻¹ respectively. Different types of adsorption isotherms and kinetic models were used to describe the Bezathren-dyes adsorption behavior. The experimental results fitted Freundlich model and the pseudo-second order kinetic models well. The results suggested that Bt-Na⁺ is suitable as a sorbent material for recovery and adsorption of Bezathren dyes from aqueous solutions.

KEYWORDS : Bentonite; Dyes; Isotherm; kinetic; Adsorption; waste-water

EFFECT OF CONCENTRATION OF CELLULOSE ACETATE IN PERFORMONCE OF ULTAFILTRATION MEMBRANE

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ABSTRACT

Ultrafiltration (UF) membrane preparation is realized through Manjikian process via phase inversion technique from casting solution consisting of cellulose acetate powder (15, 16.5, 18, 19.5 and 21%wt), acetone and formamide.

Difference in percentage of the polymer had influenced on the performance of membrane. With increase of polymer concentration, the membrane will be more compacted and also the hydrophilicity will be increased but porosity and water permeability will be decreased. For characterization of these membranes, water flux, retention of PEG and contact angle were measured. These results indicated the enhanced hydrophilicity of ultrafiltration membrane.

KEYWORDS : Ultrafiltration membrane, phase inversion, cellulose acetate, PEG, nanofiltration, interfacial polymerization.

A NOVEL THIN-FILM COMPOSITE MEMBRANES BY INTERFACIAL POLYMERIZATION FOR TREATMENT OF INDUSTRIAL WASTE WATER CONTAINING HEAVY METALS

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ABSTRACT

Industrial growth leads to the increases of industrial waste discharge into the water and environment. Particularly, higher presence of the heavy metals, such as cadmio, that tend to bioaccumulate in a biological organism, can lead to poisoning. The nanofiltration (NF) membrane process, thanks to its ease of operation, reliability and comparatively low energy consumption, is mainly used for the removal of toxic ions such as heavy metals. Recently several work reported the use of thin film NF membranes, in order to improve the performance and selectivity [1]. In this technique, a thin film is introduced by forming an ultra-thin dense layer on a porous substrate. Both chemical compositions and structures of the active skin and the substrate are crucial for preparing NF-TFC membranes with excellent separation performance. In fact, the main advantage of TFC membrane is that the membrane properties can be controlled by optimizing the characteristics of the thin selective layer and support [2-3].

In this work polyamide thin-film composite (TFC) membranes were prepared via interfacial polymerization (IP) using cellulose acetate membranes as support. M-phenylenediamine (MPD) and trimesoyl chloride (TMC) were used as monomers in water and hexane solution, respectively. The effect of different monomer concentrations from 0.1 to 0.25, and interfacial polymerization times from 15 to 90sec were investigated. Morphology was analysed using atomic force microscopy (AFM) and scanning electron microscopy (SEM). The produced TFC membranes were characterized using attenuated total reflectance-Fourier transform infrared (ATR-FTIR), porosity and pore size. Water permeability and salts rejection (NaCl, Na₂SO₄) were carried out in order to evaluate membranes performances. The obtained results showed that varying organic phase concentration and interfacial polymerization time the permeability ranged from 10,44 to 23,57 L/m²hbar. Salt rejection was from 69,23 to 83,43 % for Na₂SO₄ and from 51,95 to 70,80 % for NaCl at 2,5g/l. The results indicated that these novel membranes could be successfully applied for the heavy metals removal via NF.

KEYWORDS : Polyamide NF membrane, interfacial polymerization, heavy metals, thin film composite membranes, cellulose acetate.

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PHENOL REMOVAL BY ADSORPTION ONTO POWDRED ACTIVATED CHARBON : ISOTHERM, KINETICS STUDY AND FACTORIAL DESIGN

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ABSTRACT

The aim of this work was to study the removal of phenol by the adsorption process onto powdered activated carbon (PAC). The optimal operating conditions of PAC dose, agitation, pH and initial conductivity were determined. The experimental data best fits in Freundlich isotherm equation and the removal follow pseudo-second-order kinetics. Subsequently, a 2⁴ full factorial design implemented to evaluate statistically the most significant operating parameters and to find a simple and reliable relation between four independent variables (PAC mass, initial phenol concentration, pH and initial conductivity).

KEYWORDS : Phenol, adsorption, powdered activated charbon, Factorial design.

REMOVAL OF HUMIC SUBSTANCES BY A HYBRID PROCESS, POWDERED ACTIVATED CARBON (PAC) ADSORPTION/UF

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ABSTRACT

The objective of the present work is to study a hybrid process, powdered activated carbon (PAC) adsorption/ UF to evaluate its performance in terms of humic substances removal. First of all, The optimal operating conditions of PAC dose, agitation, pH and initial conductivity were determined. The experimental data best fits in Freundlich isotherm Equation and the removal follow pseudo-second-order kinetics. A 2⁴ full factorial design was used to evaluate statistically the most significant operating parameters. Then, the hybrid process was used and results showed a better removal of humic substances.

KEYWORDS : Humic acid, Ultrafiltration, adsorption, powdered activated carbon, Factorial design

THE USE OF COMPUTATIONAL FLUIDS DYNAMICS FOR MODELING THE FLUID FLOW BEHAVIOR AND HEAT TRANSFER PHENOMENA IN SPACER-FILLED CHANNELS FOR AGMD

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ABSTRACT

Models of woven-spacer-filled channels were studied by Computational Fluid Dynamics (CFD) for the modelling of flow and heat/mass transfer in air gap membrane distillation adopting spacer-filled channels in order to characterize the performance of (MD) modules. CFD simulations reached from steady-state conditions. The problems addressed regard the definition of dimensionless numbers (Re , f , Nu , Sh); the combined effects of the parameters that characterize the process (spacer pitch to channel height ratio l/H , flow attack angle γ and Reynolds number Re). A specific spacer aspect ratio (pitch-to-channel height ratio of 2) and three different spacer orientations with respect to the main flow (0° ; 15° and 45°) were considered. Predictions have shown that the existence of woven spacers in proximity of the membrane surface with flow orientation with respect to the filament $=45^\circ$ significantly increases mixing and heat transfer (for $Re=100$ and $\gamma=45^\circ$, the average Nusselt number was maximum { 20.96}) thus contributing to the reduction of polarization phenomena. Simulations improved that Re and γ interact heavily, making a separate-effect is impossible.

KEYWORDS: Membrane distillation, woven-spacer-filled channel, Computational fluid dynamics, Heat transfer

DESIGN OF SOLID FERTILIZER PRODUCTION PROCESS FROM DAIRY LIQUID WASTE

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ABSTRACT

A significant amount of livestock waste, consisting feces, urine and washing water, is discharging from cattle barns. In Japan, half of dairy farmers separate the livestock waste into solid and liquid fractions, while the others keep it in liquid form. The solid fraction is composted to make solid fertilizer, while some of solid compost is provided to farmers cultivating grains. The liquid fraction and unseparated livestock waste are stored in a storage tank then used as liquid fertilizers. Although the liquid fertilizer contains ammonia and sodium which might respectively cause the odor problem and salt damage, and requires special machines for the application. Moreover, direct application of the liquid fertilizer for grass could result in a high concentration of potassium which might cause grass tetany or milk fever. These factors make it difficult for farmers to apply liquid fertilizer for cultivating plants. So that, the liquid fertilizers are mainly used by dairy farmers in pasture and meadow to obtain forage resulting in over fertilizing. Therefore, production of solid fertilizers with controlled composition is required for livestock-waste management. The liquid fraction of livestock waste from cow barn is rich in nitrogen and potassium.

The proposed processes of solid fertilizers production from liquid fraction of the livestock waste consists three processes. The major solutes to be focused in the liquid fraction were ammonium, potassium, sodium and chloride ions. At the first step, the liquid fraction is concentrated by distillation process and ammonia, comprising around 60 wt.% of the total nitrogen in the liquid fraction, is separated from the fraction to be recovered by sulfuric acid. The carbon dioxide is supplied to the concentrated solution to precipitate sodium carbonate at the second step. After solid-liquid separation, the liquid is concentrated again to form the precipitation of potassium chloride at the third step. The precipitation is recovered then the liquid is returned into the second step to be mixed with the concentrated liquid fraction for keeping high concentration of ions. The objectives of this research are to propose a solid fertilizer production unit from the liquid fraction of the livestock waste and to develop a reaction model for designing the unit.

Each step for the production processes of solid fertilizer was separately assessed. For the first step, 1L of the synthetic cow urine was concentrated then analyzed the mass balance of ammonia. Carbon dioxide gas was supplied to the 500 ml of solution that contains 2.2 mol/L of KCl and 2.3 mol/L of NaCl with 0.8 mol/L of ammonia for pH adjustment until forming precipitations. The compositions of K, Na, Cl and CO₃ in both solid and liquid was analyzed. The liquid was concentrated until forming precipitations again. Then the compositions in liquid and solid were analyzed. As a result, 80% of ammonia was absorbed in the sulfuric acid and the other was remained in the concentrated solution at 8 fold concentration at the first step. For second step, 27% of Na was removed from the liquid phase and its concentration was 1.7 mol/L. This concentration is lower than 2 mol/L of Na₂CO₃ solubility in pure water, because the high ionic concentration and co-existing ions affected the solubility. The composition of the solid was 10% of K, 35% of Na and 19% of Cl by mass. So, Na can be removed in this step. At the third step, 42% of K was recovered in the solid phase and the concentration in the liquid was 2.1 mol/L. This concentration is also lower than 3.4 mol/L of KCl solubility in pure water. The composition of the solid was 48% of K, 2% of Na and 50% of Cl by mass. Then, the possibility of the production processed for the solid fertilizers were demonstrated.

MODELING AND SIMULATION OF A MICROBIAL DESALINATION CELL

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ABSTRACT

The challenge of providing safe drinking water is further complicated by population growth, industrialization, contamination of available freshwater resources, and climate change. Despite major advancements in desalination technologies, seawater desalination is still more energy intensive compared to conventional technologies for the treatment of fresh water. There are also concerns about the potential environmental impacts of large-scale seawater desalination plants.

Microbial Desalination Cell (MDC) is a newly developed technology considered a low-energy-consumption, clean technology to simultaneously purify wastewater and desalinate saline water by using the in situ energy source contained in wastewater. The principle of MDC is to use electricity-generating bacteria to consume organic matters in water and create an electrical field that separates salts in saline water.

A typical MDC consists of three chambers, an anode, middle (salt), and a cathode, separated by an anion exchange membrane (AEM, between the anode and the middle chambers) and a cation exchange membrane (CEM, between the cathode and the middle chambers) , respectively.

A microbial desalination cell proposed in the framework of the European MIDES project was modeled and simulated. The result shows the feasibility of the coupling of waste water treatment and water desalination which improves the performance of this unit.

KEYWORDS : Microbial Desalination Cell, Desalination, wastewater, electricity production

ORGANIC MATTER RECOVERY FROM WASTEWATER USING BRINE FROM REVERSE OSMOSIS AS DRAW SOLUTION

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ABSTRACT

In water scarce countries, sea water and brackish water are desalinated to produce fresh water. Reverse osmosis (RO) is commonly used to desalinate water. However, the brine, a byproduct of RO process, has negative effects on ecosystem. In the other side, the product water is delivered to consumers. During its use, organic matter (OM) and other pollutants are added. Current wastewater treatment processes degrade the OM in wastewater before its discharge. However, OM in wastewater is a potential source of energy via anaerobic digestion if concentrated to proper levels. Forward osmosis (FO) process, an osmotically driven process, is a promising technology to concentrate OM in wastewater at low energy demand. The brine from RO desalination unit is a good candidate for draw solution of FO. More concentrated brine is favorable for OM concentration using FO. However, higher concentrated brine means higher energy demand for RO because operating at higher recovery rate is needed. In this study the feasibility of OM recovery from wastewater using brine solution from RO process as draw solution is presented. We report the usage of different brine concentrations as draw solution of FO process during wastewater concentration and their implication on energy balance.

POLYOXOMETALATE-ENHANCED ULTRAFILTRATION PROCESS FOR HEAVY METALS REMOVAL

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ABSTRACT

In this study, a Keggin polyoxometalate-enhanced ultrafiltration process has been investigated for removal of toxic heavy metals such as Cd(II) and Cu(II) from wastewater solutions. $K_3 [PW_{12}O_{40}]$ as a water-soluble polyoxometalate was used for complexing the cationic forms of the heavy metals before filtration. The size of the complex has to be larger than the pores of the selected membrane so the complex can be retained. Filtration experiments were performed with ultrafiltration membrane system, equipped with organic regenerated cellulose (RC) membrane. Different parameters, affecting the percentage rejection of the metals, such as pressure, pH, polyoxometalate concentration, ionic strength have been investigated. Results obtained revealed that the maximum percentage of the metal rejection is 98 % achieved at $pH \geq 10$.

KEYWORDS : Polyoxometalates; complexation; Ultrafiltration; heavy metal removal

EVALUATION OF AN ADSORBENT BASED ON AGRICULTURAL WASTE FOR REMOVAL OF PHENYLALANINE FROM AQUEOUS SOLUTIONS

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ABSTRACT

The purpose of this work is to produce a low cost activated carbons, such as ACK and ACZ from date stones seed wastes for removal of l-phenylalanine from aqueous solutions. The activated carbons were prepared by chemical activation with potassium hydroxide and zinc chloride. Also, the materials obtained were characterized by scanning electron microscopy, N₂ adsorption-desorption isotherms and FTIR. The results show that ACK and ACZ have high surface areas and large pore volumes, which are favorable for the adsorption. Batch experiments were conducted to determine the adsorption capacities of the activated carbons. The effect of pH, temperature and contact time were studied. A strong dependence of the sorption capacity on pH was observed, the capacity decrease as pH value increase and the optimum pH value is pH 5.7. The kinetics of the adsorption showed that the adsorption behavior followed the pseudo-second order kinetic model. Additionally, the equilibrium adsorption data were well fitted to the Langmuir isotherm, and the maximum adsorption capacities of l-phenylalanine onto ACK and ACZ were 188.3 and 133.3 mg g⁻¹ at pH 5.7, respectively. Thermodynamic study revealed that the adsorption of l-phenylalanine onto activated carbons was exothermic in nature. The adsorption mechanisms were proposed with observation that hydrophobic and electrostatic interactions played the key roles in adsorption process.

Keywords : Activated carbon; l-Phenylalanine; Adsorption kinetic

OXIDATION/MINERALIZATION OF ACID ORANGE 7 BY A NOVEL ELECTRO-FENTON PROCESS USING CHALCOPYRITE AS HETEROGENEOUS SOURCE OF IRON AND COPPER CATALYSTS

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ABSTRACT

The mineralization of Acid Orange 7 (AO7) has been studied by a novel electrochemical advanced oxidation process (EAOP) consisting in electro-Fenton (EF) oxidation by chalcopyrite as heterogeneous catalyst, so-called "EF-chalcopyrite", in which chalcopyrite powder was the source of Fe²⁺ and Cu²⁺ as metal co-catalysts instead of a soluble iron salt used in classical EF. Trials were performed with a stirred boron-doped diamond (BDD)/carbon-felt cell under O₂ bubbling for cathodic H₂O₂ generation. Hydroxyl radicals formed from water oxidation at the BDD anode and in the bulk from Fenton's reaction between Fe²⁺ and H₂O₂ were the main oxidizing agents. The effect of current on kinetic decay, mineralization rate, mineralization current efficiency and specific energy consumption was examined under comparable EF and EF-chalcopyrite conditions. An almost total mineralization was achieved for a 0.28 mM AO7 solution operating at 300 mA for 6 h. The kinetic decay of the dye was followed by reversed-phase HPLC and obeyed a pseudo-first-order reaction. Ion chromatography analysis confirmed the release of NO₃⁻ and NH₄⁺ ions during AO7 mineralization.

EFFECT OF F/U RATIO ON NITROGEN RELEASE PATTERN OF UREA FORM FROM SYNTHETIC HUMAN URINE

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ABSTRACT

In the world, the amount of nitrogen fertilizers consumption keeps growing because of population increasing. Ammonia and urea fertilizers which are easily dissolved in water cause low efficiency of nutrients utilization by plants resulting from evaporation, washing out by storm water and groundwater penetration (Trenkel, 2010). Slow release fertilizers can solve this problem by insoluble property in water (Trenkel, 2010). On the other hand, human urine appeared to have an important potential for the nitrogen fertilizer owing to high nitrogen concentration. Our previous study showed a possibility to produce a slow release fertilizer of methylene urea (urea form, UF) from human urine by the reaction of urea in urine with formaldehyde under acidic condition. The ratio of formaldehyde on urea (F/U) gave differences on crystallinity, thermal properties and molecular structure. Here, the nutrient uptake curve of plants generally shows a sigmoidal pattern, while slow release fertilizers have a potential to supply nutrients respond to the demand. The fertilizer can be degraded chemically by citric acid from plant roots and biological activity in soil (Shaviv, 2005).

The objective of this research was to control nitrogen release pattern by changing F/U ratio. The nitrogen release patterns of UF for different F/U ratio (0.5, 1 and 5) and commercial one were investigated in acidic solution (pH 2 and 4) and ion exchanged water (pH 6). One gram of UF was taken into 1 L of solution. Total nitrogen (T-N) and urea nitrogen (U-N) released from UF were analyzed respectively persulfate digestion method, (Hach) and LC-MS every day for one month.

As a result, commercial UF released around 80% of T-N in all solution in one day then the release pattern reached steady state. F/U ratio 0.5, 1 and 5 slightly dissolved in ion exchanged water and pH 4 solution. The amount of released T-N increased with F/U ratio in pH 2 solution. The release patterns showed monotonically increasing. For all conditions, about 80% of T-N was consisted of U-N. This result implies the possibility to control nitrogen release pattern of UF fertilizers with F/U ratio.

BEER AND SOFT DRINKS INDUSTRY WASTEWATER TREATMENT USING AN ANOXIC-AEROBIC MBR COUPLING WITH NANOFILTRATION IN SAHELIAN CONTEXT

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ABSTRACT

Beer and soft drinks industries discharge large quantities of wastewater containing a variety of organic and mineral pollutants. Previous studies on the treatment of wastewater by membrane bioreactors (MBR) have been conducted with little interest in the acclimation conditions of the scrub biomass. This study shows the behavior of the biomass during the acclimation period and during the treatment beer and soft drinks industries wastewater by a membrane bioreactor and of the potential use of the purification performances of the coupling of an anoxic -aerobic MBR with nanofiltration for the improvement of the treated water quality for reuse. The lab scale membrane bioreactor pilot is composed of two anoxic and aerobic tanks associated with a ceramic ultrafiltration membrane. The reactor was inoculated with sludge from an activated sludge treatment plant serving domestic wastewater. The volume loads at the inlet of the bioreactor varies from 0.133g COD/L /d to 9 g COD/L/d during 300 days. The results show biomass acclimation after 196 days of operation, during regular monitoring of the pH and temperature despite high effluent concentrations of organic compounds and salts. The results confirmed the need for temperature, pH and feed flow control. At the bioreactor level, COD removal rate up to 95% was obtained at the end of the campaign as well as a reduction in feeding solution turbidity removal rate of 92 with a hydraulic retention time of 24 hours and a solid retention time of 30 days. The effect of changes in feed composition on reactor efficiency was demonstrated with the use of the real effluent with biomass perturbations and performance. The post-treatment with nanofiltration allowed more than 90% retention of the main ions contained in the effluent and allows to considering a treating wastewater reuse.

KEY WORDS : biomass acclimation, membrane bioreactor, nanofiltration, wastewater from beer and soft drinks industry.

SIMPLE PREPARATION OF Er DOPED ZINC OXIDE NANOPARTICLES AND THEIR APPLICATION IN PHOTOCATALYTIC DEGRADATION OF TEXTILE DYES UNDER UV LIGHT IRRADIATION

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ABSTRACT

In this study, Er-doped Zinc oxide nanoparticles were synthesized from ZnO nanoparticles, Er₂O₃ and H₂O through a simple route using solid state reaction. Characterizations of nanoparticles were done by using PL, UV-visible-DRS, FTIR, XRD, and SEM methods. The UV-DRS spectrum of the zinc oxide nanoparticle showed an absorption peak at round 373 nm. The FTIR graph showed peaks at 490 cm⁻¹ confirm the presence of zinc oxide nanoparticles in the synthesized samples. The crystallite size of the nanoparticles was determined using XRD data employing Scherer's formula and Hall-Williamson's plot. X-ray diffraction showed that the nanoparticles are crystalline in nature, with a spherical shape. It was observed that different concentration of Er strongly influences morphology, band gap, photoluminescence properties and photocatalytic activity on ZnO nanoparticles. Doped ZnO samples have exhibited significant enhancement in photodegradation of dye RR180 under visible light irradiation for 60min. The results of photocatalytic experiment shows the degradation percentage increases with increasing Er concentration up 3 % at wt% and after that the photocatalytic degradation was decreased.

KEYWORDS : Er-doped ZnO nanoparticles, Solid State reaction, Optical properties, Photocatalyst, RR180 and Photodegradation

SYNTHESIS OF REDUCED GRAPHENE OXIDE-POLYSULFONE ULTRAFILTRATION NANOCOMPOSITE MEMBRANES FOR WATER SEPARATION

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ABSTRACT

Recent advances in the fabrication of nanostructures such as graphene-related materials have received much attention in the membrane technology for the future of water supply.

Here we report on the synthesis of reduced graphene oxide/Polysulfone (rGO/PSf) nanocomposite material. Polysulfone (PSf) mixed matrix composite membranes containing rGO were prepared via the classic phase inversion method, using different reduced graphene oxide contents (0.02, 0.04, 0.06, and 0.08 wt %) composites.

The morphology of membranes was evaluated by various characterization methods, such as SEM, FTIR, contact angle, zeta potential, Dynamic Mechanical Analysis (DMA) and porosity measurements. The effect of the embedded nano sheet on the morphology and performance of the fabricated new membranes was investigated in terms of pure water flux, dye removal and fouling parameters. Evaluation of the ultrafiltration performance was performed by investigating the retention of Bovine serum albumin (BSA), Setazol dye and real raw textile wastewater. The performance and antifouling property of membranes was also examined by BSA protein solutions.

Experimental results showed that the water flux from the nanocomposite membranes improved significantly after addition of reduced graphene oxide to the casting solution, due to the high hydrophilicity and the enhancement of the porosity of the prepared membranes. In addition, the results showed that the 0.04 wt % rGO membrane had the highest water flux.

In terms of BSA rejection, the experiments showed a maximum increasing removal of 70% at an optimum composition of rGO equal to 0.04 wt%. However, the rejection capability of the prepared rGO blended membranes was higher than that of unfilled PES membrane (38%).

Concerning setazol dye rejection, rGO nanocomposite membranes showed low removal efficiency as the maximum dye removal did not exceed 27% at a composition of rGO equal to 0.06%. However, real raw textile wastewater filtration experiments exhibited high retentions in terms of COD (98%), Color (97%), COD (81%) and relatively moderate removal of conductivity (33-37%), for different compositions of reduced graphene oxide used.

Regarding antifouling study, flux recovery rate (FRR) of the membranes assessed by BSA solution filtration revealed that 0.08 wt% rGO membrane had the best antifouling property (FRR) = 94%, meanwhile 0.04% wt % rGO composite has the lowest one (47%).

This novel material offers a feasible candidate for practical membrane application.

KEY WORDS : reduced graphene oxide, membranes, ultrafiltration, BSA, synthetic dye, real textile wastewater.

DESIGN OF A FORWARD OSMOSIS UNIT FOR URINE CONCENTRATION AND NUTRIENT RECOVERY

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ABSTRACT

Wastewater treatment methods are moving toward water reuse and nutrient recovery. Forward osmosis was proposed for nutrient concentration from urine. This study proposed a design for the implementation of this system. A numerical model was used to assess: 1) the relationship among the draw solution volume, the concentration and the membrane area, 2) the effect of draw solution initial osmotic pressure on water and ammonia concentration factor and 3) the membrane area variation effect on the water and ammonia concentration factor. The results show 1) the required membrane area decreases with the increase of the initial draw solution concentration and volume. 2) NH_3 concentration factor slightly increase with the importance of the initial draw solution concentration. At 5 times volume reduction levels of urine, 1.1 to 1.4 concentration factor of NH_3 were obtained and 22.7 - 26.9% of NH_3 could be recovered with 300cm^2 membrane area. 3) The reduction of the membrane area from 342 to 56cm^2 enhanced the concentration factor of NH_3 that was increase from 1.4 to 3.9. To reduce 1 liter of urine to 0.2 L in 12 hours operation we suggested a membrane area of 56cm^2 and a draw solution volume of 1 L with the osmotic pressure of 32.6 MPa

KEYWORDS : Forward Osmosis, Urine, Nutrients recovery

REMOVAL OF SULFATE FROM AQUEOUS SOLUTIONS BY ELECTROCOAGULATION USING ALUMINIUM ELECTRODE

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ABSTRACT

Sulfate occurs naturally in groundwater with high levels in southern Tunisian. It is deposited in various minerals and is also one of the most important substances in the chemical industry. Environmental sulfate pollution is caused by the mining and metal industry, pulp and paper industry... Sulfate ions present in water in high concentrations may cause temporary and acute effects on humans and animals such as irritation and digestive problems and makes water bitter or astringent taste and can have laxative effects. Different methods can be used to remove sulfate from water. Proven technologies are ion-exchange, nanofiltration, reverse osmosis electro dialysis and electrocoagulation. A few earlier studies have shown that the use of electrocoagulation for sulfate removal has produced encouraging results. In this research, the performance of electrocoagulation using aluminum electrodes for removal of sulfate was investigated. Various experimental parameters such as pH, current density, electrolysis time... were studied to evaluate the performance of the electrocoagulation process. Optimum operating conditions were determined. The monitoring of energy consumption would make it possible to demonstrate the effectiveness of the electrocoagulation process.

KEYWORDS : Electrocoagulation; sulfate removal; aluminum electrode; energy consumption; Water treatment.

EVALUATION OF THE PERFORMANCE OF THE ELECTROCOAGULATION PROCESS FOR FLUORIDE REMOVAL

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ABSTRACT

In Tunisia, water resources, which are fragile, scarce and threatened, are under increasing pressure from the various socio-economic sectors. In view of the scarcity of good quality drinking water resources, treatment of the natural waters of southern Tunisia would be necessary. It is well known that fluoride in drinking water is an essential element for the human body at low levels. But it constitutes a considerable risk to health if its content exceeds the limit concentration set by the World Health Organization (WHO) at 1.5 mg L⁻¹. However, in the Gafsa mining area, fluorine levels above 2.5 mg L⁻¹ can be encountered. Various processing methods such as precipitation, ion exchange, membrane processes, adsorption and electrochemical processes have been proposed for the removal of fluorides from drinking water. The present work is a contribution to the study of the elimination of fluorides from natural waters by means of an electrochemical process: electrocoagulation. This process has been chosen because of its efficiency and simplicity. The effect of several parameters on the electrocoagulation process has been studied in order to optimize the evolution of the fluoride removal percentage and the energy consumption: pH (4 to 10), current density (0.277 to 1.388 mA/cm²) , electrolysis time (5 to 60 minutes), conductivity or NaCl concentration (0.1 to 0.7 g /L), initial concentration (3 to 12 mg /L), inter-electrode distance (0.5 to 2 cm), S/V ratio (3.6 to 14.4 m⁻¹), stirring speed (from 0 to 600 rpm), number of electrode pairs (1 to 3 pairs). The optimal conditions deduced from this experimental study are pH_i = 6, J = 0.277 mA/cm², t_{EC} = 30 min, [NaCl] = 0.5 g/L, d_i = 1 cm, S/V = 7.2 m⁻¹ and stirring speed = 300 rpm with two aluminum electrodes. . The overall removal rate obtained for synthetic water with electrocoagulation process using aluminum electrodes was over 85 % with a low energy consumption of 0.0396 kWh/m³.

KEYWORDS : Drinking water; defluoridation; aluminum electrode; energy consumption; Electrocoagulation

RECOVERY OF NICKEL IONS BY SUPPORTED LIQUID MEMBRANE (SLM) EXTRACTION

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ABSTRACT

This research is dealing with the liquid-liquid extraction and the facilitated transport through a supported liquid membrane (SLM) system of aqueous nickel (II) solution using di(2-ethylhexyl) phosphoric acid (D2EHPA) as carrier dissolved in chloroform. The effect of operational variables affecting the facilitated transport of nickel (II) through the SLM system such as: concentration of D2EHPA (in membrane), feed phase pH and initial Ni (II) concentration were investigated. Experimental results revealed that Ni (II) flux across the membrane tends to increase with the concentration of nickel ions. The optimum conditions for Ni (II) transport are: feed phase pH of 5, stripping phase of 0.5 M HNO₃ and 30 % D2EHPA (v/v). At optimal conditions the Ni (II) transport was found to be over 60 % for one cycle of 12 h.

KEYWORDS : supported liquid membrane, Nickel, extraction, D2EHPA, transport.

RADIOLYSIS OF PHARMACEUTICALS IN AQUEOUS SOLUTIONS BY IRRADIATION PROCESS

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ABSTRACT

Applying gamma irradiation is an effective advanced oxidation process (AOP) for removing pharmaceutical contaminants from wastewater as an alternative to conventional water treatment technologies. In this purpose, the degradation efficiency of several detected contaminants under gamma irradiation was evaluated. In fact, radiolysis of organic pollutants in aqueous solutions produces powerful reactive species, essentially hydroxyl radical ($\cdot\text{OH}$), able to destroy recalcitrant pollutants in water. Pharmaceuticals considered in this study are aqueous solutions of paracetamol, ibuprofen, diclofenac and fumaric acid at different concentrations 0.1-1 mmol/L, which were treated with irradiation doses from 3 to 15 kGy with 6.1 kGy/h rate. Moreover, the catalytic oxidation of these compounds by gamma irradiation was investigated using hydrogen peroxide (H_2O_2) as a convenient oxidant.

In the aim to release high degradation efficiency of considered pharmaceuticals, an optimization of the main parameters influencing irradiation process, namely irradiation doses, initial concentration and oxidant volume (H_2O_2) were investigated. Significant modifications attributed to these parameters appeared in the variation of degradation efficiency, chemical oxygen demand removal (COD) and concentration of radio-induced radicals, confirming them synergistic effect to attempt total mineralization. Pseudo first order reaction kinetics could be used to depict the degradation process of these compounds. A sophisticated analytical study was released to quantify the detected radio-induced radicals (EPR and HPLC). All results showed that this process is effective for the degradation of many pharmaceutical products in aqueous solutions due to strong oxidative properties of generated radicals mainly hydroxyl radical. Furthermore, the addition of an optimal amount of H_2O_2 was efficient to improve the oxidative degradation and contribute to high performance of this process at very low doses (0.5 and 1 kGy).

KEY WORDS : AOP, pharmaceuticals, gamma irradiation, hydroxyl radical, HPLC, EPR.

ÉTUDE THEORIQUE ET EXPERIMENTALE D'UN DISTILLATEUR SOLAIRE COUPLE A UNE POMPE A CHALEUR

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RÉSUMÉ

Ce travail porte sur le dessalement de l'eau de mer par l'énergie thermique solaire. L'eau douce est produite à travers un distillateur solaire couplé à une pompe à chaleur à compression. Un modèle mathématique théorique du système reposant sur les équations de transfert de chaleur et de matière a été établi. Une étude expérimentale du système dans différentes conditions a également été réalisée. La comparaison des résultats théoriques et expérimentaux nous a permis de valider le modèle théorique établi.

MOTS CLÉS : Distillateur, effet de serre, pompe à chaleur, énergie solaire, optimisation, modélisation, validation.

MINIMIZING THE TOTAL ANNUALIZED COST OF MED-TVC DESALINATION PLANT

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ABSTRACT

This paper suggests an estimated economic model to calculate the cost of product water for a Multi-effect thermal vapor compression desalination plant (MED-TVC). A thermodynamic model includes mass and energy balances of the system are presented. The optimization problem is to minimizing the total annualized cost (TAC) of the system (\$/m³) under a decisions variables defined constraints. A MATLAB algorithm is developed to solve the non-linear equation of the model and the main file was connected to the process simulator Aspen HYSYS which used to modeling and simulated the desalination plant. Finally, the simulation results have been compared with the industrial data of the pilot unit and shown a good agreement.

KEYWORDS : Desalination ; optimization ; total annualized cost ; MATLAB ; Aspen HYSYS

DEVELOPMENT OF A PREDICTIVE MODEL OF THE LIMITING CURRENT DENSITY OF AN ELECTRODIALYSIS PROCESS USING RESPONSE SURFACE METHODOLOGY

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ABSTRACT

Electrodialysis (ED) is known to be a useful membrane process for desalination, concentration, separation, and purification in many fields. In this process, it is desirable to work at high current density in order to achieve fast desalination with the lowest possible effective membrane area. In practice, however, operating currents are restricted by the occurrence of concentration polarization phenomena. Many studies showed the occurrence of a limiting current density (LCD). The limiting current density in the electrodialysis process is an important parameter which determines the electrical resistance and the current utilization. Therefore, its reliable determination is required for designing an efficient electrodialysis plant.

The purpose of this study is the development of a predictive model of the limiting current density in an electrodialysis process using response surface methodology (RSM). A two-factor central composite design (CCD) of RSM was used to analyze the effect of operation conditions (the initial salt concentration (C) and the linear flow velocity of solution to be treated (u)) on the limiting current density and to establish a regression model. All experiments were carried out on synthetic brackish water solutions using a laboratory scale electrodialysis cell. The limiting current density for each experiment was determined using the Cowan-Brown method. A suitable regression model for predicting LCD within the ranges of variables used was developed based on experimental results. The proposed mathematical quadratic model was simple. Its quality was evaluated by regression analysis and by the Analysis Of Variance, popularly known as the ANOVA.

KEYWORDS : electrodialysis; concentration polarization; limiting current density; response surface methodology; central composite design

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NUMERICAL STUDY OF A SOLAR DESALINATION SYSTEM BY HUMIDIFICATION-DEHUMIDIFICATION

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ABSTRACT

The present work represents a numerical study of a solar desalination system that operates on the humidification-dehumidification (HDH) principle. This system is composed essentially of a humidifier integrated into a solar collector and a tubular condenser. A mathematical model governing evaporation and condensation in the desalination unit has been developed. This model is based on energy and mass balances at the humidifier and the condenser. In order to solve the problem, the finite difference method is adopted for the discretization of the equations and the resolution is carried on the MATLAB software. The humidifier and condenser calculation codes were validated with the results of the literature. The work consists essentially of a parametric study to improve the production of the desalination unit installed at the faculty of sciences of Bizerte, Tunisia. The influence of mass flow rate and temperature of the feed water as well as the temperature and the air humidity in the humidifier on evaporated and condensed mass flow rates is studied. The results obtained then show that the evaporated and condensed flow rates in the solar desalination unit increase with the temperature of the feed water and the air in the humidifier. It should be noted that the evaporated and condensed flow rates increase up to an optimal flow rate of the feed water in the evaporator of 0.001528 kg/s whether 5.5 l/ h and then it decreases beyond this value.

KEYWORDS : Desalination, Solar energy, Humidification, Dehumidification, Energy balance, Mass balance.

MINERALIZATION OF THE ANTIHYPERTENSIVE LOSARTAN IN AQUEOUS SOLUTION BY GAMMA RADIATION

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ABSTRACT

Losartan is a common antihypertensive drug used in all areas of the world. Its phenolic intermediates are classified as persistent organic pollutants and toxic for the environment as well as human beings. In the present study, aqueous solutions of losartan were irradiated with ⁶⁰Co gamma-rays at doses of 0.5 -7 kGy. Measuring the reduction in Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC) during the irradiation process shows that the mineralization efficiency increases with increasing radiation dose. During the mineralization, four aromatic intermediates were identified by LC/MS/MS showing that irradiation process starts with the fragmentation of the molecule followed by reaction involving the hydroxyl radical, which is generated by the discharge of water.

Finally, a kinetic study based on spectrophotometric measurement showed that the degradation process is a pseudo-first order.

KEYWORDS : Losartan, gamma radiation, hydroxyl radicals

NANOSCALE ZERO-VALENT IRON FUNCTIONALIZED-*POSIDONIA OCEANICA* MARINE BIOMASS FOR HEAVY METALS REMOVAL FROM WATER

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ABSTRACT

Because of the excellent reducing capacity of nanoscale zero-valent iron (NZVI), it can be used as alternative materials for the removal of a variety of reducible water contaminants including toxic metals. The current paper reports the research results obtained for self-prepared biosorbent, *Posidonia oceanica* seagrass, activated in alkaline medium and functionalized with NZVI particles. The structural characteristics, surface morphology and binding properties of the resulting nanobiosorbent are presented. Batch comparative adsorption trials including adsorption kinetics and isotherms onto raw *Posidonia*, *Posidonia*-OH and *Posidonia*-OH-NZVI were investigated on three heavy metal ions; Cd(II), Pb(II) and Cu(II). The nanobiosorbent showed better properties, such as high reactivity and high uptake rate through the sorption process. The toxic metal removal has been monitored in terms of pseudo-first and pseudo-second order kinetics, and both Langmuir and Freundlich type isotherm models have been used to describe the sorption mechanism. The experimental data of all studied systems showed that the uptake kinetics follow the pseudo-second order kinetic model and the equilibrium uptake can adopt the Langmuir type isotherm model which assumes a monolayer coverage as the adsorption saturates and no further adsorption occurs. The thermodynamic results confirm that all sorption processes were feasible, spontaneous and thermodynamically favorable. Zeta potential data displayed that Cd(II), Pb(II) and Cu(II) tend to be reduced after exposure on the *Posidonia*-OH-NZVI surface. Furthermore, sorption competitions of the metals from binary and ternary systems were carried out onto *Posidonia*-OH-NZVI in order to gain further insight into the sorption efficiency of this material. Therefore, as a result, the proposed new nanobiosorbent could offer potential benefits in remediation of heavy metals contaminated water as a green and environmentally friendly bionanocomposite.

KEYWORDS : *Posidonia oceanica*, Nanoscale zero-valent iron NZVI, Nanobiosorbent, Metal sorption, Competitive sorption.

CADMIUM IMMOBILIZATION BY MEANS OF CALCIUM PHOSPHATES

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ABSTRACT

Phosphocalcium apatites are bioceramic analogous to the mineral component of bone, have been used extensively in such fields as bone repairs, bone implant and bioactive materials due to their excellent biocompatibility and slow biodegradation. They present remarkable interest, their availability structure, ionic exchange property, adsorption affinity, and their characteristic to establish bonds with ions of different sizes, have conferred to these materials to be efficient matrixes of water treatment.

In this context, we are interested in the possibility of using synthetic calcium phosphates such as hydroxyapatite $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ and tricalcium phosphate $\text{Ca}_3(\text{PO}_4)_2$ in order to remove cadmium from aqueous solution.

These minerals were prepared according to the “double decomposition method” in aqueous medium. Experiments consist in adding a solution of diammonium hydrogen phosphate into a boiling solution of calcium nitrate with a molar ratio of reactants Ca/P equal to 1.67 and 1.55 for hydroxyapatite and tricalcium phosphate, respectively. Both phosphates were characterized by IR spectroscopy and X-ray diffraction.

The depollution experiments consist in adding various amounts of the dissolved phosphates into the contaminated water at room temperature. Incorporation of cadmium in the apatite structure occurred by pH adjustment. The mixture was stirred for one hour and the obtained precipitate was separated from the mother solution by filtration. The metal analysis was performed using absorption atomic spectroscopy.

Assuming the predominance of the ion exchange mechanism, the obtained phases are solid solutions having the general formula $\text{Ca}_{10-x}\text{Cd}_x(\text{PO}_4)_6(\text{OH})_2$ and $\text{Ca}_{3-x}\text{Cd}_x(\text{PO}_4)_2$. The rate of substitution reached 88% on the first case and doesn't exceed 35% on the second.

The kinetic study of cadmium removal showed that the equilibrium time was quickly reached for the higher concentrations. For the low concentrations, the later doesn't exceed 60 min and 20 min for $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ and $\text{Ca}_3(\text{PO}_4)_2$, respectively.

KEYWORDS: Water treatment; Hydroxyapatite; Tricalcium phosphate, Cadmium removal.

PERFORMANCE EVALUATION OF RO BRACKISH WATER DESALINATION UNIT

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ABSTRACT

Desalination of brackish water and seawater represents an interesting alternative to supply arid and semi-arid regions with fresh water. Desalination via Reverse Osmosis (RO) is now successfully practiced in many sectors in Tunisia to meet industrial, agriculture and domestic water requirements, and has increased in popularity over the last decade. RO popularity comes from the fact that it has many advantages in terms of saving energy, flexibility for space and capacity plant compared to other techniques such as thermal process.

In this work, we are interested to study the influence of some process parameters, such as operating pressure and feed salinity in order to evaluate the performances of laboratory RO pilot. The physico-chemical characterization of different waters (feed, permeate, reject) and RO operating parameters (Recovery rate, retention rate) are determined.

Analysis of treated water confirms high membrane selectivity and the retention of bivalent ions are higher than those of monovalent ones. The recovery rate is proportional to the applied pressure up to a specific value (11 bar in our case) beyond which slightly variation is observed. The permeate salinity decrease before this same value and increases beyond this pressure.

Saturation indexes, MLSI and LSI of different samples (feed, permeate, reject) are calculated, in order to evaluate the water calco-carbonic behavior. The obtained results show that the feed water is in calco-carbonic equilibrium whereas osmotic water is very aggressive thus requiring a post-treatment to balance it. Reject is not strongly scaling and inhibitor dosing is sufficient to avoid the scaling phenomena.

KEYWORDS : Desalination, Reverse Osmosis, Saturation indexes, brackish water.

BORON REMOVAL FROM AQUEOUS SOLUTION BY ADSORPTION ONTO ACTIVATED CARBON AND AMORPHOUS CARBON

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ABSTRACT

In this work an activated carbon and an amorphous carbon were used to remove boron from aqueous solution. The two materials were characterized by infrared and Raman spectroscopies, N₂ adsorption–desorption measurements, X-ray diffraction, “Boehm” titration and measurements of pH of the point zero charge. The two adsorbents were tested for boron adsorption in aqueous solution. Despite its lowest specific surface area, the amorphous carbon showed the highest boron adsorption uptake compared to activated carbon. The surface chemistry particularly rich in carboxylic groups was responsible for the enhanced boron adsorption.

KEYWORDS : Amorphous carbon, characterization, adsorption, boron.

TOWARDS SUSTAINABLE DESALINATION INDUSTRY IN ARAB REGION : CHALLENGES AND OPPORTUNITIES

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ABSTRACT

Desalination has become one of the sources for fresh water supply in many regions of the world especially in the MENA region which hosts 50% of the world's desalination capacity. The Middle East is the largest desalination market in the world. Saudi Arabia relies on seawater desalination for 50% of its water supply and has over 30 operating desalination plant. The United Arab Emirates which relies on 70% desalinated water to supply the country. It is estimated that the region requires a 6% increase per year of desalinated seawater to sustain their water supplies. The desalination technology is nowadays a fully mature technology and is present in all areas of the world with scares fresh water resources. Population growth, socio-economic development and climatic variability have led to an increase in water demand, and desalination is one way that countries have attempted to bridge the gap between water demand and supply. Among all desalination technologies, Reverse Osmosis (RO) and Multi-Effect Distillation are the most internationally widespread technologies. However, desalination plants will always require energy. The energy consumption has been of special interest in the world of research and is the most important variable in operation cost of desalination plants. It has a direct impact on the costs reduction of the water produced. While current solutions such as RO exist, and are widely used in the seawater desalination, the water they produce is expensive. This is because high pressures are required to force the water through a membrane and maintaining this pressure requires around 2kWh for every cubic meter of water. While this is less of an issue for countries with cheap energy, it puts the technology beyond the reach of most of the world's population. Desalination offers exclusive sovereignty over produced water resources. However, the technology is energy-intensive and consequently has a large carbon footprint. In addition, it has some negative effects that include damage to aquatic ecosystems, such as sucking in fish eggs with its intake water; using harsh chemicals to clean membranes; and releasing large volumes of highly salty liquid brine back into the water. Costs vary, but the lowest price for desalinated seawater from a reverse osmosis plant is around \$750 an acre foot (325, 851 gallons) — more than double the average cost of groundwater.

Brine and heat from desalination plants have potentially detrimental environmental impacts that can be costly to manage. In addition, GCC countries for instance have very limited storage capacity necessary to maintain supplies during interruptions in plant operations. In the Gulf region, operation of desalination plants can be suspended for days during red tides. To remain a viable option in a world, renewable energy sources have to be used to meet at least part of its power requirements. The coupling of solar energy with desalination technologies is seen as having the potential to offer a sustainable route for increasing the supplies of desalinated water. However, the success in implementing solar desalination technologies at a commercial scale depends on the improvements to convert solar energy into electrical and/or thermal energies economically as desalination processes

need these types of energies. Engineers and entrepreneurs across the globe are now trying to devise greener desalination. Some are inventing new alternatives to traditional reverse osmosis. One of the hottest new technologies on the bench in laboratories in the U.K., Saudi Arabia, and South Korea and elsewhere is one-atom thick, perforated graphene membranes that can cut reverse osmosis desalination to a fraction of its current cost. Developed at the Massachusetts Institute of Technology, the membrane's pores can be tuned to optimize permeability. The hang-up for now is how to mass-produce the material. Several alternative technologies have also been developed recently; those based on capacitive deionization have shown considerable improvements in their salt removal capacity and feed water recovery. In the same category, microbial desalination cells have been shown to desalinate high salinity water without any external energy source, but to date, scale up of the process has not been methodically evaluated. There is a need to continue providing opportunities for innovation that spark ideas from those not traditionally engaged in development. Moreover, we need to engage experts across diverse sectors and fields who can bring their knowledge and skills to bear on significant issues. By focusing on problems for which new technologies are critical, we can invest in innovation and a new paradigm of technologies for a new set of users. In the near term we are likely to see continued reductions in cost and energy consumption for water desalination, specifically for reverse osmosis technologies. In the long term it is difficult to predict which of the many competing technologies will dominate the desalination market, however it is almost certain that the technology will move past reverse osmosis to more cost effective and energy efficient systems.

KEYWORDS : Innovative Technology, Desalination, Sustainability, Forward Osmosis, Renewable Energy.

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NOVEL COMPOSITE MEMBRANE BASED ON RECYCLED LOW-DENSITY POLYETHYLENE-ALUMINA FOR MEMBRANE DISTILLATION

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ABSTRACT

In this study, composite membranes were preparing using recycled low-density polyethylene (RLDPE), thus helping to lighten plastics load on the environment, and alumina to reinforce these membranes and make its more hydrophobic. The preparation of these membranes was made by thermal induced phase separation (TIPS) method in which was used butyl acetate as a solvent; hexane as a non-solvent and PEG as pore-formers. The crystalline property of the membrane was studied via Fourier transform infrared spectroscopy (FT-IR) in hopes of revealing differences in functional groups between the various membranes. The characterization of these membranes in terms of thickness measurements, contact angle, pore size, porosity, mechanical test, bubble point pressure, AFM and SEM analysis showed that the addition of alumina and PEG had an important role in improving the contact angle and the porosity. Although, the results of RLDPE-alumina membrane revealed good porosity, more hydrophobic and better mechanical properties. The obtained membranes were applicate on the vacuum membrane distillation to test their performance.

KEYWORDS : Recycled Low Density Polyethylene; alumina; membrane; hydrophobic; pore formers; TIPS

TREATMENT OF HARDNESS ON TUNISIAN UNDERGROUND WATER BY THE NEW BALLASTED ELECTROFLOCCULATION PROCESS

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ABSTRACT

This study evaluates the performance of Ballasted Electroflocculation using aluminum electrodes for removal of non-carbonate hardness in phosphate process water. Based on the examination of the operation parameters one by one, the best removal percentage was obtained at a current intensity of 2 A, a the flow rate of 20 L/h, a micro-sand dose of 6 g/L, a polyéthylèneimine (PEI) polymer dose of 100 mg, the contact times of 30 min, a stirring speed of 50 RPM, a monopolar configuration of the electrodes, and an electrodes number of 10. In comparison, filterability was found to be more sensitive to number of electrodes, micro sand dosages and current density. It was dependent on the ratio of microsand to PEI polymer dosage, and improved when this ratio increased. The production of primary coagulant during electrolysis improved flotation of both calcite CaCO_3 and magnesium hydroxide ($\text{Mg}(\text{OH})_2$). Optimized hardness removal by the Tunisian underground water showed highly efficient hardness removal with an overall removal rate of 87 %. The investigation of BEF process proposes a highly cost-effective wastewater treatment method if compared to Actiflo TM and electrocoagulation.

KEYWORDS: New wastewater treatment process, Electrochemistry, Ballasted electroflocculation; Micro sand; Mining wastewater treatment; Response surface methodology; Hardness Removal.

TREATMENT OF HEAVY METALS -POLLUTED INDUSTRIAL WASTEWATER BY BALLASTED ELECTROFLOCCULATION PROCESS

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ABSTRACT

This laboratory study investigated the parameters efficiency of the new technology: ballasted electro-flocculation (BEF) using aluminum (Al) electrodes to remove cadmium and zinc from industrial mining wastewater (MWW). The principle of the BEF process is based on the use of micro-sand and polymer together to increase the weight of the flocs and the rate at which they settle is radically changing the electrocoagulation-electroflocculation settling methodology. Based on the examination of the operation parameters one by one, the best removal percentage was obtained at a current intensity of 2 A, a the flow rate of 20 L/h, a micro-sand dose of 6 g/L, a polyéthylèneimine (PEI) polymer dose of 100 mg, the contact times of 30 min, a stirring speed of 50 RPM, a monopolar configuration of the electrodes, and an electrodes number of 10. The results showed that the flow rate and the current density have a preponderant effect on the variability of the quality of the settled water. In comparison, filterability was found to be more sensitive to number of electrodes, micro sand dosages and current density. It was dependent on the ratio of microsand to PEI polymer dosage, and improved when this ratio increased. Response surface methodology was applied to evaluate the main effects and interactions among stirring speed, polymer dose, current intensity, and electrodes number. The removal of Cd and Zn from industrial MWW was done for very low cost of 0.1 TND/m³ equivalent to 0.04 €/m³. The investigation of BEF process proposes a highly cost-effective wastewater treatment method if compared to Actiflo TM and electrocoagulation.

KEYWORDS : New wastewater treatment process, Electrochemistry, Ballasted electroflocculation; Micro sand; Mining wastewater treatment; Response surface methodology; Heavy metals removal; Low operating cost.

SEAWATER DESALINATION AND ITS IMPACT ON THE ENVIRONMENT

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ABSTRACT

The idea of separating salt from sea water is ancient and dates since 1790. The first largest desalination plant was built in 1938 in Saudi Arabia. The potential benefits of seawater desalination are numerous but the economic, environmental, cultural and commercial costs are significant. Seawater desalination is used in almost 130 countries with more than 10,000 desalination plants providing, more than 1% water compared to conventional water production, with various technologies (membranes and thermal processes). Although desalination is energy intensive and generates releases of brackish water that can alter the marine environment, the desalination technologies are of great interests in countries with severe water scarcity and access to the sea and financial means.

The areas around the Mediterranean, especially in the south, are very arid and freshwater is insufficient. The increase of the population leads the states to choose the production potable water from the sea. But investment costs are far from being the most important consideration. Indeed, these operational operating costs, as consumption of chemical, electrical products and the question of their environmental impact are far from resolved. Most often, the establishment of desalination plant facilities is a way to get around the glaring problems of waste or bad governance of the water and to evade the necessary reforms. In addition, there is also the problem of brine; a desalination plant generates a large amount of brine composed of various salts, heavy metals, organic compounds...

In some cases, desalination is a way for the authorities to avoid the difficulties of water governance or to around political conflicts related to water sharing.

It should also be noted that the quality of the desalinated water must be closely monitored, in particular with regard to some chemical elements whose rate must not exceed the standards.

KEYWORDS : Desalination, Seawater, Environment, Energy, Governance.

ETUDE DE L'ADSORPTION D'UN COLORANT SUR UN BIO ADSORBANT

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RESUME

Les eaux usées issues des industries textiles sont fortement contaminées par les colorants. Ces molécules constituent des polluants organiques biorécalcitrants ayant un effet néfaste sur l'environnement, d'où la nécessité de traiter ce type de rejet hydrique. Dans ce contexte on se propose d'étudier l'adsorption d'un colorant, le rouge de méthyle, sur un bio adsorbant préparé à partir d'un déchet agroalimentaire : les pelures d'orange. Après la préparation du bio adsorbant, une caractérisation physique et chimique a été effectuée. L'étude de l'adsorption du rouge de méthyle sur ce bio adsorbant a été entamée d'abord par une étude préliminaire portant sur l'optimisation des paramètres expérimentaux à savoir la vitesse d'agitation ainsi que le rapport masse/ volume et le pH. L'effet de ces paramètres ainsi que leurs interactions a été aussi estimé. Cette étude a été clôturée par la détermination des conditions optimales d'adsorption. L'ensemble des résultats montre que ce procédé constitue une alternative efficace et écologique des techniques de traitement et valorisation des déchets agros alimentaires.

MOTS CLES : Adsorption, Rouge de méthyle, Bio adsorbant, Optimisation.

OPTIMIZATION OF DYES REMOVAL BY ADSORPTION ONTO ACTIVATED CARBON

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ABSTRACT

Use of various dyes in order to color the products is a common practice in textile industry. The presence of these dyes in water even at low concentration is harmful and causes health hazards. In this study the removal of dyes from aqueous solutions by activated carbon has been investigated as a function of solution pH, initial concentration, adsorbent dose of activated carbon and temperature. The dyes removal was determined by spectrophotometry. This method has been validated according to the French method validation standard NF 90-210 (2009). In order to determine the effect of the main parameters and their mutual interaction for the adsorption process, a full factor design of the type 2^k has been used. Response surface methodology (RSM) was applied in the development of statistical analyzing, modeling and interpreting the resulted data of dyes removal by adsorption.

KEYWORDS : Activated carbon, Dyes, Validation, Factorial design, Optimization.

NICKEL REMOVAL FROM WASTEWATER BY ELECTROCOAGULATION USING ALUMINIUM ELECTRODES : EFFECT OF ELECTROCOAGULATION PARAMETERS

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ABSTRACT

As one of the heavy metals Nickel is considered one of the most hazardous. It is essential for the living being, but it becomes toxic and sometimes fatal in high concentrations. For these reasons, Ni-contaminated wastewater has imperatively to be treated before being discharged. This study was designed to investigate the effect of some chemical and electrochemical variables in order to improve as much as possible nickel removal and significantly reduce the cost of electrocoagulation (EC) process. The performance of electro coagulation process with aluminium electrodes for nickel removal on laboratory electrochemical cell was studied. The effect of pH, electrolysis time t_{EC} , current density j , the concentration of NaCl, area volume ratio S/V and the mode of connection (bipolaire- monopolaire) on nickel removal was explored. Based on the examination of the operation parameters one by one, the best removal percentage was obtained at: pH= 5.0, $j = 1.388 \text{ mA/cm}^2$, $t_{EC} = 30 \text{ min}$, $[\text{NaCl}] = 1.5 \text{ g/L}$, $d_{ie} = 1 \text{ cm}$, $S/V = 7.2 \text{ m}^{-1}$ and monopolaire connection. The obtained results showed that a removal of 91% was achieved with an energy consumption of $W = 0,095 \text{ KW h/m}^3$. Subsequently, the suitability of the EC process for the treatment of industrial wastewater was evaluated.

KEYWORDS : Electrocoagulation, Nickel removal, EC parameters, Aluminum electrodes, wastewater.

SEPARATION OF COPPER(II), CHROMIUM(III) AND NICKEL(II) FROM NITRIC SOLUTIONS BY POLYMER INCLUSION MEMBRANE

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ABSTRACT

An experimental investigation of copper(II), chromium (III) and nickel(II) ions extraction and separation from nitric aqueous solutions by transport through polymer inclusion membrane (PIM) is presented. PIMs are formed by casting a solution containing a carrier (D2EHPA), a base polymer (CTA) and acetylated kraft lignin (AKL) as filler, to form a thin, flexible and stable film. The membrane was characterized to obtain information regarding its composition using FT-IR and SEM. Several important transport parameters such as the amount of D2EHPA, the thickness of the membrane, the type of the stripping solution and the pH of the feed phase are discussed. Cu(II) and Ni(II) ions were effectively removed from the source phase by transport through PIMs with D2EHPA into 1M HNO₃ as receiving phase while Cr(III) was not detected in the receiving phase. The best initial flux and permeability coefficient are obtained for the membrane with 3.18 mg.cm⁻² of D2EHPA as carrier.

KEYWORDS : ions extraction; polymer inclusion membrane; acetylated kraft lignin; D2EHPA; transport parameters.

CHROMIUM REMOVAL BY ADSORPTION ON ORANGE PEELS : OPTIMIZATION OF INFLUENCING PARAMETERS

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ABSTRACT

Cr(VI) is a well-known highly toxic metal, considered as a priority pollutant. Industrial sources of Cr(VI) include leather tanning, metallurgy, cooling tower blowdown, plating, rinse waters, etc. The removal of poisonous Cr(VI) from industrial wastewater by low-cost abundant adsorbents such as Orange peels was investigated. The influence of different parameters such as particle size, contact time, pH, adsorbent dose, metal concentration, adsorbent nature and temperature was studied. Obtained results showed the equilibrium data were well fitted ($R^2 = 0.994$) the Langmuir and Temkin isotherms. The adsorption of Cr(VI) on Orange peels follows second-order kinetics. The adsorption process is endothermic showing monolayer adsorption of Cr(VI), with a maximum adsorption of 97% at 35°C for an initial concentration of 10 mg L⁻¹ and 1 g of adsorbent at pH 2. Thermodynamic parameters were also evaluated.

KEYWORDS : Chromium, removal, biosorption, orange peels

APPLICATION OF RESPONSE SURFACE METHODOLOGY FOR THE SPECIATION OF CADMIUM IN NATURAL WATERS USING CLOUD POINT EXTRACTION

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ABSTRACT

A cloud point extraction-preconcentration by the formation of complex was applied to the determination of trace Cd^{2+} in natural waters. The method is based on the formation of a complex of Cd^{2+} with dithizone (DT) in the presence of Triton X-114 in pH=4 and mixed micelle-mediated extraction of the complex. The use of cloud point extraction (CPE) coupled with spectrophotometric detection allows the determination of cadmium at micrograms levels in water. The effects of some important variables such as temperature ($^{\circ}C$), the pH, volume of chelant solution (μL) and Triton X-114 volume (mL) were studied using central composite design (CCD) and the optimum experimental conditions were evaluated by the desirability function (DF) combined with response surface methodology (RSM). The proposed method allowed the determination of cadmium (II) in the range $5 - 60 \mu g.L^{-1}$ with good precision and accuracy and the detection limit was found to be $2.85 \mu g.L^{-1}$. Additionally, simulated natural waters were treated successfully by cloud point extraction at optimum conditions. The method was successfully applied to the determination of cadmium in natural waters.

KEYWORDS : Cloud point extraction, response surface methodology, cadmium, spectrophotometer, speciation, natural waters.

SPECIATION OF MERCURIC IONS FROM NATURAL WATERS BY CLOUD POINT EXTRACTION : EVALUATION AND OPTIMIZATION USING CENTRAL COMPOSITE DESIGN

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Abstract

In the present study, a new, low-cost, micellar sensitive and selective spectrophotometric method was developed for the speciation of mercury (II) species in natural waters. Cloud point extraction (CPE) was used for the efficient preconcentration of $Hg(II)$ in the selected samples. The method is based on the formation of a complex of $Hg(II)$ with dithizone (DT) in the presence of Triton X-114 in acidic medium. Response surface methodology approach using central composite design was employed for modeling, evaluating and optimizing the influence of H_2SO_4 volume, temperature ($^{\circ}C$), volume of chelating agent (DT) and Triton X-114 volume. The $Hg(II)$ extraction efficacy obtained reached up to 98.8%. The proposed method allowed the determination of mercury (II) in the range $40 - 400 \mu g.L^{-1}$ with good precision and accuracy and the detection limit was found to be $14.668 \mu g.L^{-1}$. The interference effect of some anions and cations was also tested. The proposed method was successfully applied for the preconcentration of trace mercury in natural waters samples prior to its determination by spectrophotometer UV-vis at $\lambda_{max} = 490$ nm with satisfactory results. The proposed method is an efficient, rapid, simple and inexpensive microextraction technique and was successfully applied for the determination of mercury in various water samples.

KEYWORDS : Cloud point extraction, central composite design, mercury, spectrophotometer, preconcentration, natural waters.

REMOVAL OF BORON FROM GEOTHERMAL WATER BY REVERSE OSMOSIS AND ADSORPTION ONTO ACTIVATED CHARCOAL ORIGINATED FROM PALM BARK: EXPERIMENTAL DESIGN AND BREAKTHROUGH CURVES MODELING

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ABSTRACT

Boron removal from geothermal water was studied using reverse osmosis membrane. Under normal operating conditions, boron removal efficiency cannot exceed approximately 49%. The adsorption column process has been tested for the treatment of permeate of reverse osmosis, to improve the water quality and to reduce the boron concentration in geothermal water. The activated carbon used in this work was prepared from the palm bark. This adsorbant presents a very high efficacy for the removal of boron from the permeate of the reverse osmosis. The application of the CCD experimental design methodology allows setting the optimal conditions for boron adsorption by column. The application of these conditions allows easily produce a water containing 0.175 mg / L of boron with a percentage of elimination greater than 96%.

KEYWORDS : Boron, geothermal water, reverses osmosis, adsorption, column study, CCD experimental design, mathematical modeling

EQUILIBRIUM MODELING FOR ADSORPTION OF AQUEOUS PHENOL ONTO ACTIVATED CARBON : LINEAR VERSUS NONLINEAR REGRESSION ANALYSIS

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ABSTRACT

Removal of phenolic pollutants from wastewaters has become mandatory due to stringent environmental regulations and adverse effects on aquatic marine environment. Adsorption process is the most effective process to remove pollutants. Adsorption parameters determined from equilibrium modeling provides a powerful tool to understand adsorbate-adsorbent interaction mechanism but there is an on-going debate about pros and cons of linearizing isotherm equations. Therefore, in the present study, a comparison of linear and nonlinear regression forms of Langmuir, Freundlich, Dubinin-Radushkevich, Temkin and Redlich- Peterson equilibrium models were applied on experimental data obtained from batch adsorption of aqueous of phenol onto granular activated carbon (GAC). For this, six error analysis methods were used: the coefficient of determination (R^2), the sum of the squares of the errors (SSE), the sum of the absolute errors (SAE), the average relative error (ARE), the hybrid fractional error function (HYBRID) and the Chi-square test (χ^2). The comparison between different models such as Langmuir, Freundlich, Dubinin-Radushkevich, Temkin and Redlich- Peterson, showed that model Freundlich and Redlich- Peterson were more suitable to describe the equilibrium data. Linear and nonlinear regression methods were compared while non linear regression performed better for analyzing experimental data for isotherm analysis. This study illustrates a practical relevance in exploring the potentiality of granular activated carbon to remediate water pollution.

KEYWORDS : Equilibrium, adsorption, linear regression, nonlinear regression, GAC, phenol

ADSORPTION OF CADMIUM FROM AQUEOUS SOLUTION BY BIOADSORPTION USING A MARINE PLANT, POSIDONIA OCEANICA: KINETICS, EQUILIBRIUM, AND THERMODYNAMICS

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ABSTRACT

The leaves of the marine plant *Posidonia oceanica* (L.) were used as a new bioadsorbent for the removal of cadmium from artificially contaminated aqueous solutions. The experiments were performed in batch as well for the kinetics as for the adsorption isotherms. The experimental variables studied are the pH, the temperature, the amount of biomass and the initial concentration of Cd (II). The maximum biosorption was observed for a pH = 6.5. The biosorption capacity appears to be optimized by an increase in temperature, amount of biosorbent and initial concentration. Modeling of the experimental data has shown that the pseudo-second-order model describes the adsorption kinetics adequately. Similarly, the adsorption isotherms are in agreement with the Dubnin-Astakhov model (D-A). In addition, the thermodynamic analysis revealed that the adsorption process studied is a favorable, exothermic and spontaneous phenomenon.

KEYWORDS : Adsorption, feuilles de posidonie, cinétiques, isothermes, thermodynamique

OPTIMIZATION OF A NEW METHOD FOR NICKEL DOSAGE IN INDUSTRY EFFLUENTS WATER USING ET-AAS

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ABSTRACT

Nickel compounds and metallic nickel have many industrial and commercial applications, including use in stainless steel and other nickel alloys, catalysts, batteries, pigments, and ceramics. However, nickel is toxic for humans even at low doses, and is known to be a human carcinogen. For this reason, the Tolerate Limits Values (TLV) for Ni in occupational environment are becoming more and more lower. Consequently, sensitive analytical methods are required to ensure environmental monitoring of the exposure to this element.

In this work, we developed a simple, economic, sensitive and reproducible method for Ni determination in industry aqueous effluents using Electro-thermal Atomic Absorption Spectrometry. The method was validated by checking its linearity which ranged from 0.5 to 20.0 $\mu\text{g}\cdot\text{L}^{-1}$, with a regression coefficient exceeding 0.998. Twenty micro liters (20 μL) of sample were injected into the graphite tube for Ni quantification. The detection and quantification limits were 1.8 and 6.29 $\mu\text{g}\cdot\text{L}^{-1}$, respectively. The reliability of the method was checked by the analysis of chromium standard solution certified reference material. The extraction recovery was around 98 %. The method is repeatable and all the relative standard deviations were <5%. The result was a simple, inexpensive and sensitive method of Ni determination in aqueous samples. The method was applied for nickel determination in industrial waste waters after Nickel-plating surface treatment.

EQUILIBRIUM MODELING OF SINGLE AND BINARY ADSORPTION OF CR(VI) AND PHENOL ONTO DOWEX 1X8 ION EXCHANGE RESIN: KINETIC AND THERMODYNAMIC STUDY

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ABSTRACT

Removal and recovery of toxic metals and organic compounds from wastewater by adsorption is an efficient alternative. This work investigates the adsorption of Cr(VI) and phenol from single and binary aqueous solutions using Dowex 1X8 ion exchange resin. The morphology of adsorbent was examined under Scanning electron microscope (SEM) and FTIR spectrum. Kinetic studies under different temperatures were performed. Kinetic models were adjusted to experimental data, and the pseudo-second-order model presented the best fitting. Multicomponent adsorption isotherms such as non-modified competitive Langmuir, modified competitive Langmuir, extended Langmuir, extended Freundlich, non-modified competitive Redlich Peterson and modified competitive Redlich Peterson models have been employed and compared. Thermodynamic study depicted that adsorption of phenol onto Dowex 1X8 was spontaneous and endothermic while for Cr(VI) was exothermic in nature. The experiments demonstrated that Dowex 1X8 resin had a good potential in the efficient removal of Cr(VI) and phenol from wastewaters.

KEYWORDS : Binary adsorption, Ion exchange resin, Multicomponent isotherm, Kinetic models

APPLICATION OF RESPONSE SURFACE METHODOLOGY FOR CHROMIUM REMOVAL BY BIOSORPTION

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ABSTRACT

Wastewater contamination by chromium becomes an important problem due to its widespread applications in industrial processes such as metallurgy, tanning industries, refractories and foundries. Chromium is harmful for environment and threatens the human health as it is a carcinogen element. The World Health Organization defined an upper limit of 0.05 mg L⁻¹ in drinking water. Different studies were carried out on the efficiency of low cost natural adsorbents for heavy metals removal. This work focuses on the efficiency of the response surface methodology to optimize the parameters affecting the chromium removal by biosorption on orange peels. Fourier transform infrared spectroscopy (FTIR), BET and Boehm method were used to characterize the biosorbent. A Doehlert experimental design was applied to determine optimum conditions. Three factors were chosen: the biosorbent amount, pH and the temperature.

The characterization of the adsorbent revealed that the pH of zero charge is equal to 2, the specific area is about 2.42 m² g⁻¹. The experimental results were analyzed by the ANOVA test and showed that the model regression is acceptable. The determination coefficient R² was equal to 0.995 suggesting an excellent relationship between predicted and experimental responses. Graphic analysis of contour plots obtained from NEMROD software showed that the highest removal yield was obtained under the following conditions : an adsorbent dose of 1.14 g, a pH equal to 2 and a temperature of 34.1°C. The adsorption recovery reached 97% under these conditions.

KEYWORDS : Chromium, Biosorption, Response surface methodology.

APPLICATION OF A LOW COST ADSORBENT FOR BORON REMOVAL

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ABSTRACT

Boron is an important micronutrient for plants, animals and humans but the excess and the deficiency of this element are harmful. The World's Health Organization WHO recommended a limit value of 2,4 mg L⁻¹ of boron in drinking water. Different studies were conducted on the use of biomasses as biosorbents for water treatment. In this work, boron removal was investigated using banana peels as a low cost biosorbent. Our biomass was characterized using the Fourier transform infrared spectroscopy (FTIR), the thermal decomposition of the biosorbent (TGA), the ash content, the Boehm method and pH of zero charge. The effect of different factors on boron adsorption was studied such as the particle size, the contact time, the pH, the adsorbent amount and the agitation speed. The results showed that the equilibrium was reached after 15 minutes. The optimum conditions for boron removal by biosorption were found to be : particle size < 100µm, pH equal to 6, an adsorbent dose of 4 g, a concentration equal to 5 mg L⁻¹ and an agitation speed of 100. The adsorption recovery reached 65% under these conditions.

KEY WORDS : Boron removal, biosorption

USE OF ELECTRODIALYSIS TO REMOVE CADMIUM FROM WATER USING RESPONSE SURFACE METHODOLOGY

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ABSTRACT

In this study, response surface methodology (RSM) was used to optimize the experimental conditions in cadmium removal using electro dialysis. A preliminary study was carried out in order to investigate the effect of the operating parameters which are the pH of the solution, the volume flow, the coexistence of the magnesium ions and the electro dialysis time, the determination of the effect of sodium chloride and volume flow on current density. Favorable elimination was obtained when the flow rate was low $10 L h^{-1}$, the pH was 4. Analysis of variance (ANOVA) showed that the quadratic model of cadmium elimination by electro dialysis is highly significant ($R^2= 0.9916$). PARETO's analysis shows that the volume flow of the solution is the most influential factor with a negative effect, followed by the coexistence of the magnesium ions and then the pH of the solution and finally the electro dialysis time has a negative effect but not significant. Their positive, insignificant interactions are verified by the response surface. According to the previous conditions and for a desirability equal to 1, the percentage of elimination of cadmium by electro dialysis equal to 70.6%.

KEYWORDS : Cadmium removal, Electro dialysis, Response Surface Methodology (RSM).

THE OPTIMIZATION OF A SIMULATION STUDY ON AN AGMD MEMBRANE DISTILLATION UNIT AND THE EXPERIMENTAL VALIDATION FOR DESALINATION OF SEAWATER OR BRACKISH WATER

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ABSTRACT

This work consists in presenting the results of an invention for a membrane system coupled to an efficient and robust solar collector which produces fresh and high quality water and a low percentage of brine independent of the source salinity. salt water and study the experimental characterization of membrane distillation with air gap (AGMD) is carried out on a pilot plant. The one-dimensional (1-D) air membrane distillation (AGMD) model for the sheet-like plate-type has been developed. This model is based on equations that describe heat and mass transfer mechanisms of a single-stage AGMD process. It can simulate AGMD modules in co-current and countercurrent flow regimes. The theoretical model has been validated using experimental data. During the tests, we used synthetic brackish water (which varies from 4.2 to 12.5 g / l of salts). The results show that the flow of permeability increases so that the temperature and feed speed increase and the thickness of the space decreases (from 6.12 to 1.5 millimeters). At the same time, the phenomenon was modeled using Matlab programming on heat transfer and mass transfer aspects. The 1D model, based on the transfer equations and the correlations of the literature, clearly shows the phenomena present in the membrane distillation pilot. The maximum permeate flux obtained was 12.8 kg / m² with a hot fluid temperature of 80 ° C, a 1.5 mm gap and hot and cold water flow rates of 4.5 l / min. For all the measurements, the maximum relative difference between the experimental and simulated results is 10% for the temperature of 80 ° C. The results of hot fluids at low temperature can be interesting in the project of coupling of the solar energy.

KEYWORDS : desalination, membrane distillation, AGMD, solar energy, coupling

RESPONSE SURFACE METHODOLOGY FOR OPTIMIZATION OF BORON ADSORPTION BY ACTIVATED CARBON : ISOTHERM AND KINETICS STUDY

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ABSTRACT

In this study, response surface methodology (RSM) was used to optimize the experimental conditions in the adsorptive removal of boron from aqueous solution over commercial granular activated carbon (GAC). The studied parameters are the pH of the solution, the temperature, the adsorbent mass and the coexistence of sulfate ions. The analysis of variances (ANOVA) showed that the quadratic model of boron ion removal rate is highly significant ($R^2 = 0.972$). The graphical representation of the Pareto diagram shows that the pH, with a negative effect, is the most influential factor, followed by the temperature and the coexistence of sulfate ions which have a negative effect also. The mass of the adsorbent has the least significant effect, its increase causes a slight increase in the rate of removal of boron. In order to determine the optimal conditions giving a better elimination, the desirability study shows that we can reach a maximum rate of 55.73% at pH equal to 6, temperature of 10 ° C, a mass of activated carbon of 5g and without coexistence of sulfate ions. The adsorption isotherm and the kinetics study were carried out using the optimum conditions determined previously. The correlation coefficients and the values of the "Chi-square" test show that the adsorption can be described according to the Freundlich model and that the adsorption kinetics follow the pseudo-first-order model.

KEYWORDS : Boron removal, Response surface methodology, adsorption models, kinetic models.

APPLICATION OF RESPONSE SURFACE METHODOLOGY FOR BORON REMOVAL FROM WATER BY ELECTRODIALYSIS

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ABSTRACT

The main purpose of this work is to study the removal of nitrate from water using electrodialysis. The influence of several parameters, such as flow rates, initial pH, co-existing anions and electrodialysis time on process efficiency were studied. Response Surface Methodology was applied in the development of statistical analyzing, modeling and interpreting the resulted treatment data of boron removal by electrodialysis. Fractional factorial design has been applied for the simultaneous study of the effects of operating parameters on boron removal response. The effectiveness of the considered design parameters was well examined to find the optimum experiment condition.

Boron removal by electrodialysis showed to be independent of the electrodialysis time. While The flow rate as well as the pH of the feed solution and also the coexisting anions on the feed solution play a significant role on the deboronation efficiency.

KEYWORDS : Electrodialysis, Boron, Response Surface Methodology, Factorial design, Optimization

**EFFECT OF PHYSICO-CHEMICAL PARAMETERS
ON THE INTERACTION BETWEEN METHYLENE BLUE
AND POLY(ACRYLAMIDE-CO-STYRENE-CO-2-ACRYLAMIDO-2-
METHYLPROPANE SODIUM SULFONATE)**

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ABSTRACT

The interaction of a cationic phenothiazine dye, Methylene blue (MB) with a tri-copolyelectrolyte (PE): poly(acrylamide- styrene-co acrylamido methyl propane sulfonate), has been investigated by spectrophotometric method. The polyelectrolyte induced metachromasy resulting in a blue shift of the absorption maxima of the dye, in agreement with the formation of a dye H-aggregates. The stability of the polyelectrolyte/dye complexes in aqueous solutions was studied as a function of polyelectrolyte hydrophobicity, polyelectrolyte concentration, polyelectrolyte electrostatic charge density f , NaCl salt addition, Ethanol addition and Ethanol treatment. It was found that the stoichiometry of PE-MB complex evaluated by the molar ratio method is 2:1. Reversal of metachromasy was observed upon ethanol addition and less importantly with ethanol treatment. Finally, thermodynamic parameters of the interaction between the polyelectrolyte and the dye at different temperatures, have been evaluated to determine the binding constant and as a consequence, the stability of the complexes.

KEYWORDS : dye, flocculent, polyelectrolyte, dye/polyelectrolyte complex stability, water treatment

EXPERIMENTAL STUDY OF MEMBRANE DISTILLATION FEASIBILITY FOR SEA WATER DESALINATION

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ABSTRACT

Nowadays, consumption of fresh water is continuously increasing in several areas and demand is exceeding reserves in many countries. Effective water management programs and tools need to be established, and brackish water desalination processes will play a fundamental role in the future of resources primarily in drinking water.

Membrane distillation (MD) is an unconventional technology, which is gaining interest because it's advantageous in terms of energy consumption, simplicity and its ability to couple with renewable energies such as solar energy or geothermal sources.

The driving force in MD is the difference in vapor pressure induced by the temperature difference across a hydrophobic membrane and to operate temperatures below 90 ° C are suitable.

Hence, to study membrane distillation a test bench was designed and built according to the DCMD (Direct Contact Membrane Distillation) configuration. In this configuration the hot feed solution is in direct contact with the hot side surface of the membrane, where evaporation takes place. The vapor is displaced by the pressure difference across the membrane towards the permeate side and condenses inside the membrane module. Due to the hydrophobic nature, the feed solution cannot penetrate the membrane (only gas phase exists inside the pores of the membrane).

Overall, the study was mainly about heat and mass transfer and tests were performed on the bench to examine the influence of feed temperature on the permeate flux, experiments were conducted for four hours with different feed temperatures reaching 65 ° C on the hot side and 20 ° C on the cold side, giving a steam flow of 26.85 kg / m²h. In each experiment, real sea water was used with 40.46 g / L salinity, compared to 2.6 g / L for the permeate obtained, which gave a salt rejection rate of 95%.

The experiments were carried out successfully and the preliminary results were promising and motivating.

TREATMENT OF TEXTILE RELEASES BY MEMBRANE TECHNIQUES STUDY OF CLOGGING AND THE UNCLOGGING

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ABSTRACT

The membrane techniques have shown so far their effectiveness as a solution for the cleaning and the recycling of the textile effluents. However, the phenomenon of fouling seems to be their major disadvantage, thus causing a crucial reduction in the productivity and the high cost of maintenance. Trying to contribute to the existing efforts to cure to this problem, our study is related to the analysis and the development of the parameters which assign the fouling and the cleaning of the NF membranes during the filtration of the textile effluents containing reactive dyes. This study enables us to get rid of this phenomenon which coexists during the frontal filtration of the solutions containing a mixture of «dye-salt ». For this purpose, three theoretical models for this phenomenon study, were compared and a regeneration efficiency index allows to increase the optimal conditions of this operation.

KEYWORDS : Nanofiltration ; clogging ; unclogging ; textile releases ; membrane

NATURAL ZEOLITE FOR ELIMINATION OF FLUORIDE FROM DRINKING WATER

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ABSTRACT

Fluoride is one of the anionic contaminants which is found in excess in surface or groundwater because of geochemical reactions or anthropogenic activities such as the disposal of industrial wastewaters. The presence of fluoride in drinking water at optimum concentrations (recommended level is 1 ppm) prevents dental caries, but at high concentration it is detrimental to health. The teeth and the skeleton can be affected. Due to all previously mentioned fluoride pollutions and health problems that it causes, the World Health Organization (WHO) has specified the tolerance limit of fluoride content of drinking water as 1.5 mg/L. Several defluoridation methods proposed and tested worldwide are mostly based upon the principles of precipitation, ion exchange, membrane processes, but the adsorption process is generally accepted as the cheapest and most effective method for removal fluoride from water. Natural zeolite, was used to remove fluoride from aqueous solutions.

Batch adsorption experiments were conducted to examine and optimize various operational conditions such as adsorbent dose, initial fluoride concentrations, temperature and the effect of other anions naturally present in the drinking water as sulfate, chloride and bicarbonate.

Kinetic study reveals that the fluoride adsorption by Natural Zeolite follows both pseudo-second order kinetic model. The experimental data fitted well to Langmuir adsorption isotherm.

Overall, the presence of carbonate ions significantly diminished the fluoride adsorption capacity, while the presence of nitrate and sulfate ions did not show any significant effect; the anion removal efficiency by Natural Zeolite followed the order $F^- > HCO_3^- > Cl^- > SO_4^{2-}$.

Low cost of Natural Zeolite makes this material a potential candidate for defluoridation of water.

BORON REMOVAL FROM WATER BY ADSORPTION ONTO ACTIVATED CARBON (PREPARED FROM PALM BARK) IN BATCH PROCESS AND FIXED BED COLUMN

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ABSTRACT

The occurrence of boron in water and their inefficient removal is the key issue in desalination and water treatment. Adsorption by fixed bed column is usually used to remove mineral and organic contaminants from aqueous phase. The adsorption of the boron onto activated carbon, prepared from palm bark, was studied. The physicochemical properties of this activated carbon were characterized by elemental analysis (EA), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), N₂ adsorption/desorption, Raman spectroscopy and zeta-potential analysis. Batch adsorption experiments were developed in order to determine the equilibrium time and the best isotherm model. The kinetic adsorption data can be described by the second-order equation. Among the adsorption isotherm models, Langmuir and Sips models gave better fit of the equilibrium data. The calculated thermodynamic parameters showed that the boron adsorption is no spontaneous and exothermic in nature. The effects of inlet boron concentration, feed flow rate and weight of activated carbon on the fixed-bed adsorption were determined by two-level factorial experimental design. Breakthrough and saturation times were higher at higher adsorbent weight and lower flow rates. The increase of boron initial concentration decreased breakthrough and saturation times. The volume treated per gram of activated carbon was higher at lower initial concentrations and at higher adsorbent weight. Fractional bed utilization (FBU) increased with higher initial boron concentration and lower amount of activated carbon. Yan model better fitted the experimental data of the breakthrough curves with R² of 0.993.

KEYWORDS : adsorption; palm bark activated carbon; batch process; fixed-bed column; boron; experimental design

ONCE-THROUGH MULTISTAGE FLASH DESALINATION PROCESS COMBINED WITH THERMAL VAPOR COMPRESSION MSF-OT/TVC

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ABSTRACT

Recently, improving the thermal efficiency of system at low cost has become one of the most important objectives of the sustainable development in the field of desalination. In this context, we tried to develop, in this research work, an integrated technology of thermal desalination which combines the process of the once-through multi-stage flash desalination (MSF-OT) with the unity of thermal vapor compression (TVC). Our study was carried out to estimate the improvement of this system performance based on the energy consumption and the production capacity of fresh water. The equations of this model were resolved through an iterative procedure by using the solver Fsolve of the MATLAB software. The analysis of the obtained results showed that using thermal vapor compression improves process performance indicators. Indeed, the enhancement of the performance ratio reached 73% and that of the specific flow rate of cooling water attained 2%. The results also revealed that, when the withdrawal of the entrained vapor was performed at the stages located in the beginning of installation, the performances of the indicators improved. Besides, this study demonstrated the influence of the top brine temperature on the performance of installation. It can be noted that the thermal performance ratio increases with the rise of top brine temperature T_{b_0} .

KEYWORDS : Fsolve; MSF-OT; performance indicators; thermal vapor compression

IMPROVEMENT OF PERFORMANCE INDICATORS OF MULTISTAGE FLASH DESALINATION PLANT

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ABSTRACT

Multistage flash desalination plants are energy intensive and it is, therefore, important to use operating parameters that lead to reduction of energy consumption and consequently reduction of fresh water production cost. In this study, an optimization of operating parameters of an actual MSF-BR desalination plant was performed using as objective the improvement of the main plant performance indicators. Four decision variables related to the operating conditions were chosen for optimization, and a multi-objective function that consists of the main plant performance indicators, i.e., the thermal performance ratio, the specific cooling water flow rate, the specific recirculating brine flow rate, and the specific feed flow rate, were considered. In order to achieve this we have used a multi-objective solver available in the MATLAB optimization toolbox. This solver uses genetic algorithms for finding the Pareto-optimal solutions. The optimization results reveal that a significant improvement of the performance indicators can be obtained.

KEYWORDS : Multistage flash; Performance indicators; Matlab optimization solver; Genetic algorithms; Pareto-optimal solutions.

PURIFICATION OF THE WASTE WATER BY COAGULATION – FLOCCULATION TREATMENT OF THE CITY OF ANNABA (EAST OF ALGERIA)

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ABSTRACT

From a lime produced at the steel complex (Annaba, Algeria), we carried out purification and co-precipitation of the suspended elements and colloids of the waste water of the city of Annaba (east of Algeria). This study focuses on investigating the evolution of the pollution criteria parameters. We first demonstrated the effectiveness of calcium hydroxide in the co-precipitation of urban waste water compared to conventional coagulants, and then we characterized the quality of the purified waste water. We have found from the results obtained that, unlike the case of natural waters, lime is a good precipitant for urban waste water. Co-precipitation is accompanied by a notable reduction in the rates of chemical pollution factors (the case of the ortho-phosphates is significant) and a reduction in bacteriological pollution to values below the accepted standards.

KEYWORDS : lime, waste water, purification, coagulation, co-precipitation, flocculation.

PRODUCTION DU BIOÉTHANOL PAR FERMENTATION ALCOOLIQUE D'UNE BIOMASSE RICHE EN SUCRE : OPPORTUNITÉ ÉNERGÉTIQUE ET ENVIRONNEMENTALE

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RESUME

De nos jours, les combustibles fossiles, qui sont à la base du pétrole, se raréfient. De plus, le monde entier connaît en ce moment un engagement grandissant pour un environnement renouvelable. Résultat? Utilisation des biocarburants (bioéthanol et biodiesel) d'origine végétales. La motivation principale du développement des biocarburants (bioéthanol et biodiesel) est le gain environnemental potentiel que les biocarburants apportent par rapport aux carburants pétrochimiques.

Selon l'Agence internationale de l'énergie (AIE), les biocarburants compteront pour 12 % des stocks mondiaux de carburant liquide d'ici 2030, et ce pourcentage passera à 26% d'ici 2050. En 2008, les biocarburants représentaient un peu plus de 1 % de l'ensemble des carburants liquides pour moteurs. A ce titre, on s'est intéressé à la réalisation de la fermentation alcoolique d'une biomasse riche en sucre ; les déchets de dattes de deux variétés ; à l'échelle laboratoire afin d'optimiser le rendement en bioalcool par kg de biomasse ; cette réaction est régie par des conditions opératoires très critiques pour cela notre première étape de travail a consisté à déterminer les paramètres du bon fonctionnement de la fermentation alcoolique.

Les résultats de notre étude a montré que la température optimale de la fermentation alcoolique est de 30°C, le pH varie de 6-5,5, l'agitation est de 150 tr/min, le temps de séjour de la réaction est de 72h et pour une concentration de 300g/l de glucose des déchets de dattes de nature moles on produit une concentration de 280g/l en éthanol c'est-à-dire une productivité de 3,88g/L/h d'éthanol pour une masse de biomasse de 165g. Dans le cas des déchets de dattes sèches de masse 173g, on a trouvé pour une concentration de 100g/L de glucose on produit 320g/L d'éthanol et avec une productivité de 4,44g /L/h.

MOTS CLES : biocarburant, bioéthanol, énergie, fermentation, biomasse sucre..

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